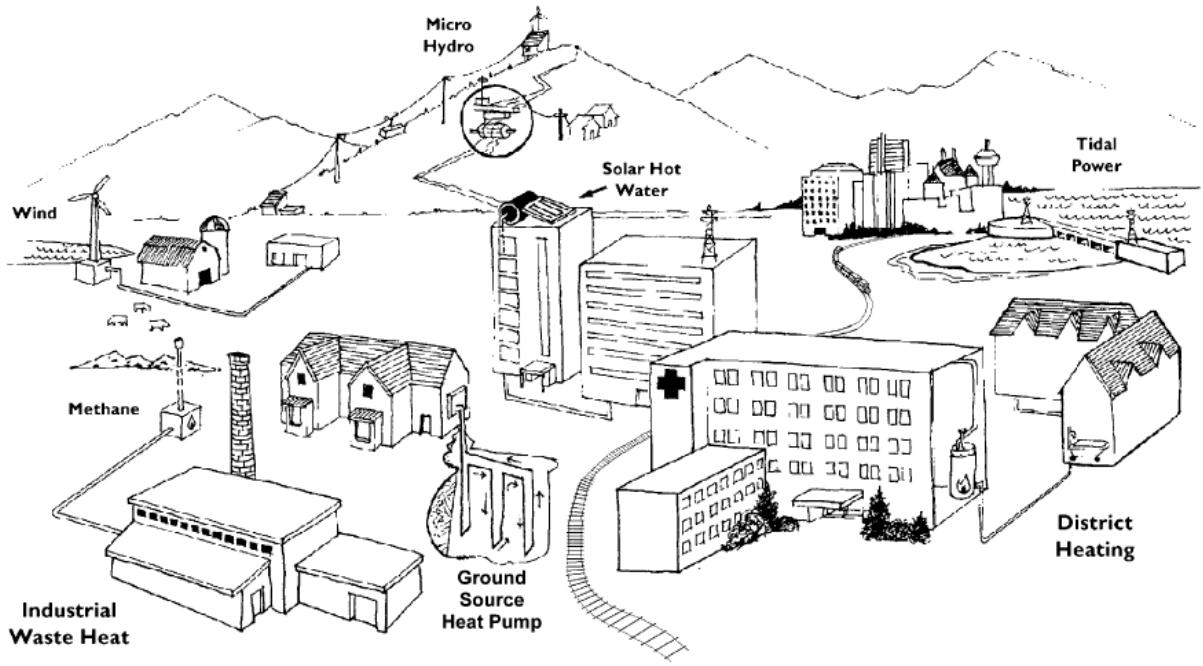
Energy Planning for Sustainable Communities:
Sustainable Pickering's Journey



Distributed Energy System, circa 2050

Source: Sheltair 2001, 4

Signature of Student	Signature of Supervisor
DIANNE PERKIN	JOSE ETCHEVERRY

Dianne Perkin
202517548

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Abstract

Energy is essential to the quality of life that citizens have come to expect but it has come at a price. Increased greenhouse gas (GHG) emissions have contributed to climate change – altering weather patterns and rendering communities vulnerable to more intense storms and climatic conditions – and degrading air quality – increasing smog and air pollution leading to increased respiratory illness and affecting the health of millions. Clearly the way we power our communities needs to be rethought.

Environmentalists agree that municipalities, citizens, planners and business (including utilities) need to work together as the challenge is too large for any one sector to undertake on its own. Sustainable community energy planning (CEP) seeks alternatives to our current energy paradigm – replacing fossil fuel with renewable energy (including solar and wind) and considering different generating and distribution systems. Innovative technologies exist and working models demonstrate alternatives (such as district energy, waste to energy and eco-industrial parks). Municipalities will need to identify opportunities and create partnerships to implement SCEP. Yet while many communities are planning to become more sustainable and have created action plans and targets few have implemented them.

Planners, as stewards of cities and experts in understanding sustainability and its importance to communities, can act as facilitators enabling this transition through the planning process by using their tools (zoning, by-laws, density controls and building and infrastructure design) and by helping municipalities to collaborate with business. In a carbon-constrained future, business will also need to rethink their business models to become more carbon efficient and be willing to be active partners in achieving more sustainable communities.

The City of Pickering embarked on their sustainability journey in 2005, has laid a solid foundation for creating a sustainable community and is now considering how to implement their Local Action Plan. Using Pickering as a case study, this paper considers three questions regarding using CEP in creating sustainable communities: what are the opportunities and constraints, what can we learn from Pickering's sustainability journey, and lastly what needs to be done towards achieving our goal of using CEP to create sustainable communities?

Foreword

This paper is the result of a learning journey at York University that is exploring sustainable development, planning and business and the environment. It is also the product of a Plan of Study that takes an inter-disciplinary approach combining my concentration on the MES Planning Stream and the Graduate Diploma in Business and the Environment with a practical internship in Sustainable Energy at Enbridge Gas Distribution and that builds on practical work experience preceding my graduate studies.

The August 2003 blackout was a turning point where I realized how I took energy for granted. However, it was during a trip to Fort McMurray in August 2007, that my academic interest in energy emerged and it was during the Enbridge internship (Fall 2007) that the concept of sustainable community energy planning (SCEP) was introduced to me. Working closely with Chris Gates and Tim Adamson at Enbridge, we explored how SCEP could be a strategic business opportunity for a regulated utility. Energy became the integrator linking planning and business and sustainability.

Planners historically have focused on land-use planning leaving energy considerations up to experts in the Ministry of Energy and other governmental agencies. In Ontario, Premier McGuinty is promoting a "culture of conservation", energy efficiency measures and the use of renewables. This paper analyzes energy planning for sustainable communities by considering the intersection of traditional urban planning and energy planning and uses the term 'journey' to describe the transition to a better collective understanding and practical application of both disciplines to achieve more sustainable communities. This paper views SCEP from the municipality's perspective and considers the integral role of energy planning for sustainable

communities, the planner's evolving role in collaborating with utilities to facilitate municipal goals and new energy solutions, and on how to operationalize community energy plans.

Sustainable Pickering is working to implement their local action plan - milestone four of the ICLEI program. Like Pickering, many Canadian communities have completed greenhouse gas (GHG) base-lining, set targets for future GHG emissions and developed Local Action Plans (milestones one to three), however, relatively few have made the transition to implementing and monitoring these plans (milestones four and five) and this transition has proven more difficult than initially anticipated. In fact, the FCM Sustainable Community Conference in February 2008, "Moving Innovation into Action", was designed around this transition. It is this aspect of the ICLEI program that is explored in this paper and energy issues are considered to be an integral component of the sustainability journey.

A carbon–constrained future will also impact business and those that do not adjust to this new reality may find that revenues decline, profitability decreases, shareholder confidence wanes and stock values fall. Thus, there exists a motivation for energy businesses (including utilities) to find solutions, seek new opportunities, and justify SCEP as a significant business opportunity.

This paper seeks to augment existing knowledge in several ways. Firstly, it synthesizes the planning related aspects of sustainability discourse to gain better understanding of the concept itself, to situate community energy planning within it and to understand theoretical approaches to sustainability. Secondly, it considers how planners can facilitate energy planning for sustainable communities and how they can engage utilities to participate in finding and implementing practical solutions to climate change. Thirdly, it considers how a municipal approach can be effective. Lastly, initial findings indicate that research does exist in many of these areas individually however the consideration of how energy, planning and business overlap and the

consideration of SCEP as a planning role and business opportunity seems to be lacking. Consideration of the intersection of these areas may lead to new opportunities. In developing an expertise in these planning areas it is my goal to be able to assist Pickering and then other municipalities in implementing critical policies towards achieving more sustainable communities.

Acronyms

AMO	Association of Municipalities of Ontario
ATES	Aquifer Thermal Energy System
BAU	Business as Usual
BC	British Columbia
BTES	Borehole Thermal Energy System
CanREA	Canadian Renewable Energy Alliance
CanSIA	Canadian Solar Industry Association
CanWEA	Canadian Wind Energy Association
CBOC	Conference Board of Canada
CC	Climate Change
C-CIARN	Canadian Climate Impacts and Adaptation Research Network
CCP	Cities for Climate Protection
CDEA	Canadian District Energy Association
CDM	Conservation and Demand Management programs
CEM	Community Energy Management
CEP	Community Energy Planning
CEPEI	Canadian Energy Partnership for Environmental Innovation
CES	Community Energy System
CETC	CANMET Energy Technology Centre
CHP	Combined Heat and Power
CIDA	Canadian International Development Agency
CIP	Community Improvement Project
Cities^{Plus}	Cities - Planning for Long-term Urban Sustainability
CMHC	Canada Mortgage and Housing Corporation
CO_2	Carbon Dioxide
CSCD	Centre for Sustainable Community Development (FCM)
CUI	Canadian Urban Institute
DE	District Energy
DOE	Department of Energy (USA)
DSM	Demand-Side Management
EGD	Enbridge Gas Distribution or “Enbridge”
EIP	Eco-Industrial Parks
ENGO	Environmental Non-Governmental Organization
ESCO	Energy Service Companies
FCM	Federation of Canadian Municipalities
GBC	Green Building Council
GGH	Greater Golden Horseshoe
GHG	Greenhouse Gas
GMF	Green Municipal Fund
GTA	Greater Toronto Area
GVRD	Greater Vancouver Region District
HBR	Harvard Business Review

ICLEI	International Council for Local Environmental Initiatives or Local Governments for Sustainability
ICSC	International Centre for Sustainable Cities
ICSP	Integrated Community Sustainability Planning
IESO	Independent Electricity System Operator
IEU	International Energy Association
IGU	International Gas Union
IISD	International Institute for Sustainable Development
IPCC	Intergovernmental Panel on Climate Change
IPSP	Integrated Power System Plan
IUCN	International Union for Conservation of Nature
LAP	Local Action Plan
LDC	Local Distribution Company
LEED	Leadership in Energy and Environmental Design
LEED-ND	Leadership in Energy and Environmental Design - Neighbourhood Design
MGH	Municipality of Grey Highlands
MMAH	Ministry of Municipal Affairs and Housing
MOE	Ministry of Energy
NGO	Non-Government Organization
NRCan	Natural Resources Canada
OEB	Ontario Energy Board
OECD	Organization for Economic Co-operation and Development
OEE	Office of Energy Efficiency
OMA	Ontario Medical Association
OPA	Ontario Power Authority
OPG	Ontario Power Generation
OPPI	Ontario Professional Planning Institute
PIA	Planning Institute of Australia
PCP	Partners for Climate Protection
PPS	Provincial Policy Statement (Ontario)
SCEP	Sustainable Community Energy Planning
SCIP	Sustainable Community Indicators Program
SDTC	Sustainable Development Technology Canada
SWOT	Strengths, Weaknesses, Opportunities and Threats Analysis
TAR	Third Assessment Review
TBL	Triple Bottom Line
TNS	The Natural Step
TRCA	Toronto Region Conservation Authority
UK	United Kingdom
USA	United States of America
UTES	Underground Thermal Energy System
WBCSD	World Business Council for Sustainable Development
WCED	World Commission on Environment and Development
WTEF	Waste to Energy Facility

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1: Introduction

1.1 Problem Statement

Energy is our lifeline: providing light in the dark, heating and cooling for home comfort, heating to cook our meals, refrigeration to preserve our food, and power for industry. It is essential for transportation and mobility, for urban design and planning and for economic development. Our current energy paradigm is based on cheap abundant energy available in unlimited quantities. As Figure 1 illustrates, the energy use of cities is so great that it is visible from outer space and while energy provides the quality of life that we now take for granted, it has come at a high price.

Figure 1 Energy use of cities is so great that it is visible from outer space.

Source: Cities[Plus] submission to Sustainable Urban Systems Design Competition, Tokyo, June 2003

Academic research and experts' presentations inform us of the consensus within the scientific community that greenhouse gas (GHG) emissions are causing climate change – largely

because of burning fossil fuels – a fact that has substantial and widespread implications for Canada. In addition, scientists have shown that climate change is resulting in increased incidents and intensity of storms rendering our urban areas more vulnerable. Furthermore, fuel emissions contribute to air pollution and smog which in turn leads to decreased air quality affecting the health of millions and are also linked to acid rain leading to decreased air and water quality affecting a large portion of Canada's natural environment.

Environmentalists' concerns over GHG emissions, growing energy costs and lack of energy security have recently widened towards mainstream society. This growing civic consciousness has led to the questioning of our current energy mix, quantity and rate of consumption of non-renewables and suggests a shift in energy policy. Academic theorists have proposed new paradigms that focus on conservation and renewable energy sources and different distribution systems as solutions to energy woes. Businesses too are becoming more environmentally concerned, shifting their focus from profits alone to the triple-bottom-line. Environmentalists recognize that solutions are beyond the ability of any one sector to achieve alone thereby necessitating a multi-sectoral approach.

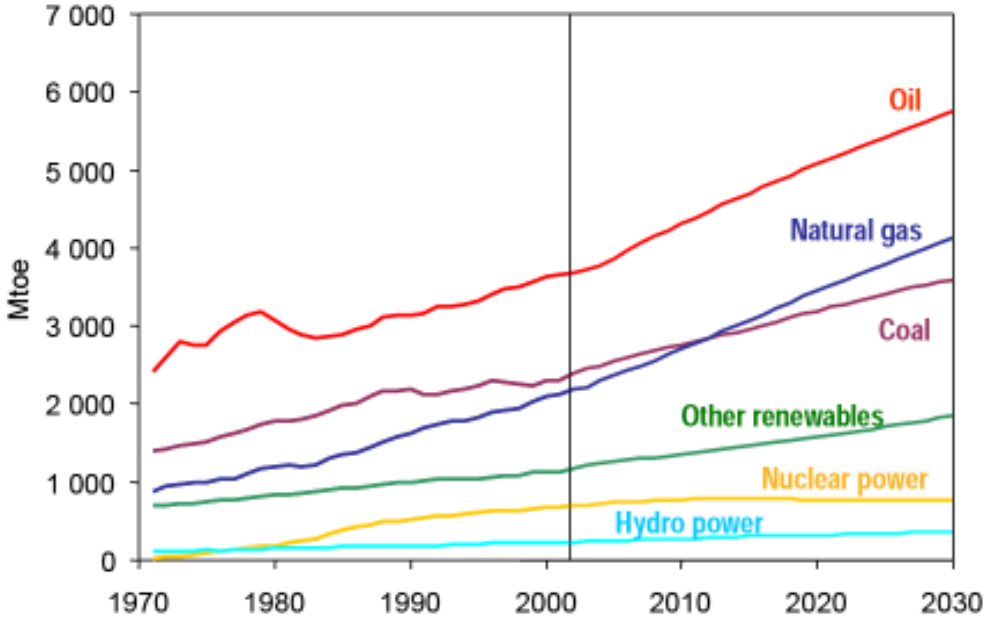
While climate change is a global problem, local-level action is critical to slow the rate of GHG emissions and to address issues of pollution. The challenge of creating more sustainable communities forces us to rethink energy provision which has evolved from wood to coal to fossil-fuels. Sustainable community energy plans can contribute to the triple bottom line (economically, socially and environmentally), while mitigating and adapting to climate change and ensuring a more stable, reliable and local energy system.

1.2 Overview

As Runnalls (2008, 10) concludes, the biggest challenge to sustainable development is climate change. Much of the climate change problem results from burning fossil fuels which are central to the energy policy of modern societies and which Birol (2006, 3), Chief Economist with the International Energy Association (IEA), projects will account for almost 90% of the growth in world energy demand between 2006 and 2030 as Figure 2 illustrates. Figure 3 illustrates the energy flows through the economy and as the Conference Board of Canada (CBOC: June 2007, ii) notes,

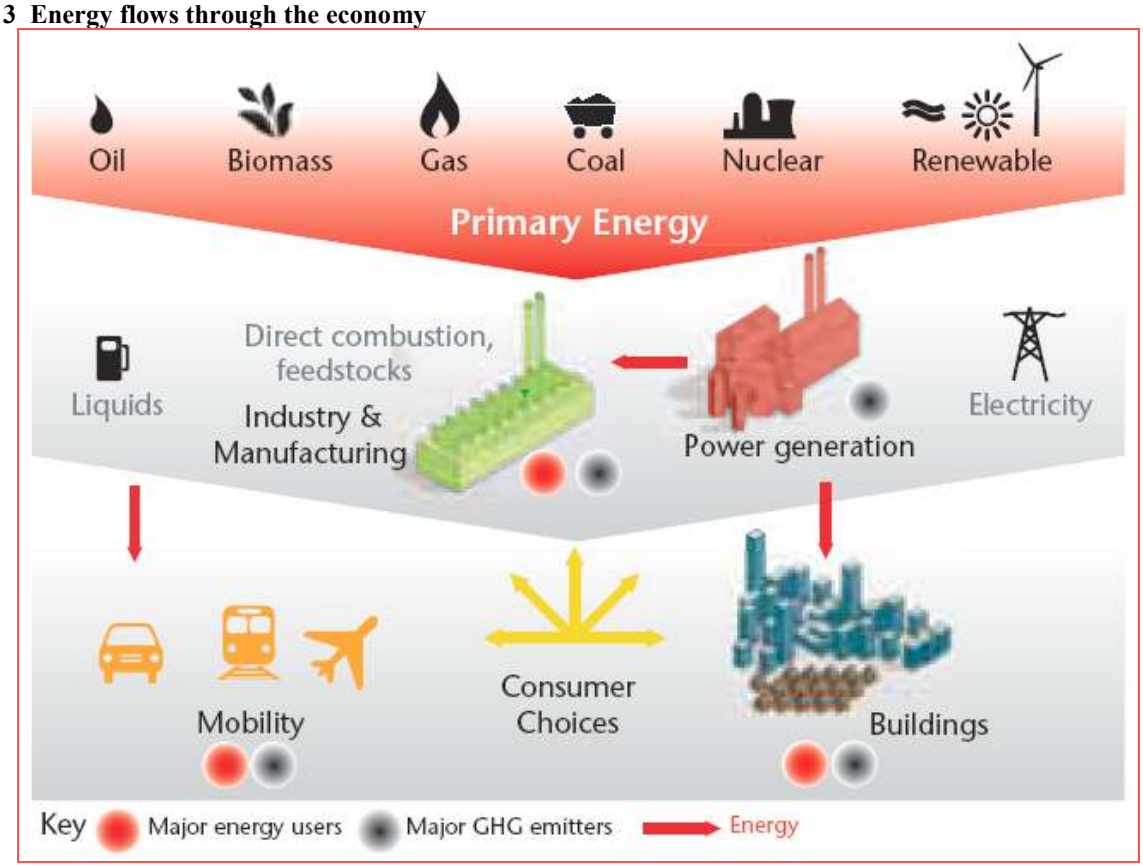
> "Current policy has led to a strong energy industry that has contributed to national prosperity, but the policy was developed within the context of unconstrained GHG emissions. As we come to terms with a lower carbon emissions future, our competitiveness will depend on a comprehensive strategy, collaboration among governments, investments in low-carbon-emission technologies, an attractive investment climate and, perhaps most importantly, an integrated policy vision that reflects energy and environmental imperatives".

Figure 2 IEA World Primary Energy Demand



Source: Birol 2006, 3.

Figure 3 Energy flows through the economy



Source: WBCSD Pathways to 2050, 2006.

The CBOC (March 2006) questions and examines adaptation and mitigation strategies - challenging Canadians to deal with this serious problem. The Brundtland commission (1987) presented the concept of sustainable development and it has since entered our current lexicon. However, there is no consensus of opinion among people as to its meaning, measurement or its deemed success. Fortunately, in Canada, many municipal (local) governments are rising to this challenge and are providing practical examples on how to address sustainability by focusing on sustainable community energy planning (SCEP). For example, Drake Landing in the Town of Okotoks, Alberta is demonstrating that a SCEP model is technically possible (see Figures 4-5). Still, many challenges remain: expertise to install leading-edge technology is limited,

partnerships are difficult to create and economic viability is complicated to demonstrate within current accounting parameters. Successful SCEPs will require specially tailored planning infrastructure and in our neo-liberal political economic reality, new plans so that municipalities can effectively engage utilities and other energy businesses, create new partnerships, nurture and embrace business relationships and encourage them to adopt a more sustainable model of energy supply.

Figure 4 Okotoks, Alberta - Large scale solar thermal energy solutions

Photo source: Wong and Snijders (2007).

Figure 5 Okotoks, Alberta - Solar collectors over garages

Photo source: Wong and Snijders (2007).

Environmentalists appreciate how much is at stake and that the challenge is too great for any one sector to tackle on its own. Businesses, too, are considering the consequences of climate change – reframing their long-term vision, restating their corporate visions and mission statements and reworking their business models and approaches. Multi-stakeholder efforts will necessitate collaborations, forming new partnerships and encouraging team members from governments, businesses, utilities, planners and community groups to work together. However, facilitating this transformation will not be easy as all have differing mandates and stakeholder expectations to satisfy.

The challenge to making these partnerships successful is to establish common goals, for the public good, that mitigate emissions and adapt to climate change by making our communities more sustainable. The key to success remains keeping this over-arching goal unified, harnessing the benefits that each "brings to the table" and smoothing out "bumps along the way". Effective facilitation is necessary for achieving consensus on the vision, and to continue moving the process along.

Planning at the provincial level currently ignores energy issues for example, the June 2005 *Places to Grow* legislation of the Province of Ontario demonstrates the pervasive assumption that, "if you build it, the energy will come". The *Act* states that "planning must occur in a rational and strategic way" and that its purpose is to "enable decisions about growth to be made in ways that sustain a robust economy, build strong communities and promote a healthy environment and a culture of conservation". Beyond noting that the contents of a growth plan may contain, "policies, goals and criteria in relation to … non-renewable resources and the conservation of energy", no further details are provided on how this will be accomplished or who

will be involved. Given that the existing regime has produced our current reality it seems naive to just assume that things will change by this statement alone.

At the municipal level policies regarding community planning and development have usually taken place without utility involvement - the electric or natural gas Local Distribution Companies (LDCs). SCEP is a timely and important part of the solution. Currently the Ontario Energy Board (OEB) is reviewing the energy plan proposed for the province by the Ontario Power Authority (OPA). The Integrated Power System Plan (IPSP) includes the promotion of renewable energy and conservation. Therefore, the time is right for municipalities to reconsider their power sources and move to an energy regime with new partnerships and a new renewable energy technology mix (including wind and solar).

Soon community energy planning and sustainable community development will be common language and innovative financial partnerships will be critical. Drake Landing Solar Community at Okotoks, Alberta will be regarded as mainstream and we will wonder why we did not embrace this model earlier. Municipal Governments will build sustainable energy requirements into their community plans and approval processes, Provincial Governments will ensure that the Building Code includes provisions for the mounting and installation of solar panels and other sustainable energy necessities and planners will design with community energy planning in mind and will be the facilitators to making this transition happen.

1.3 Research focus and relevance

Planners historically have focused on land-use planning leaving energy considerations up to experts in the Ministry of Energy and other governmental agencies. In Ontario, Premier McGuinty is promoting a “culture of conservation”, energy efficiency measures and the use of

renewable energy. The Ministry of Energy, along with its related agencies and boards such as the Ontario Energy Board (that oversees regulated utilities) are mandated to reinforce this. The *Energy Efficiency Act* resulted in the formation of the Ontario Power Authority (OPA) now charged with planning and designing Ontario's future energy system. Given that the OPA is predicting an energy gap between supply and demand in the next twenty-five years and the above noted environmental problems that have resulted from our province's current electricity system, the time is right for reconsideration of Ontario's energy paradigm. Consideration of what other municipalities and countries have proposed and/or undertaken is crucial. One example of an attractive energy paradigm that embraces new technologies is district energy including renewable energy (see findings section for further elaboration).

The Ministry of Municipal Affairs and Housing (MMAH) is responsible for Ontario's existing planning regime. Traditional planners' tools include zoning, bylaws, permits and building codes. Recently, an increase in environmental concerns has resulted in the "Smart Growth" and "compact cities" initiatives aiming to make cities more sustainable and healthier. Planners now realize the environmental importance of building designs and urban layouts and the connection between land-use and energy consumption. Planners are educated and respected to reconfigure the built environment and are often leading researchers in recognizing the importance of multi-sectoral partnerships. This paper considers the integral role of energy planning for sustainable communities, the planner's evolving role in collaborating with utilities to facilitate municipal goals and new energy solutions, and how to operationalize community energy plans.

This paper assumes that community energy planning should be a national initiative even though electricity provision mostly falls within provincial jurisdiction. However, the scope of the

paper is narrowed to the province of Ontario to fit within the length and time requirements for this MES major paper. In considering the term "sustainable communities" this paper uses municipalities as the "unit of measurement" and recognizes the wide diversity in scale (difference) and population size (10,000 to 4 million plus) that such a unit entails. This unit is adopted to comply with the focus of the Federation of Municipalities (FCM) initiatives.

Addressing all aspects of energy requirements for sustainable communities is a broad undertaking that is beyond the scope of this paper. Therefore, this paper focuses on the non-transportation energy needs of communities. In particular, the paper focuses on energy for appliances, equipment, lighting and space heating and cooling needs for residential, commercial and industrial use which combined constitute approximately 32% of the energy used in Canada (NRCan website, Statistics Canada 2005).

Education and civic engagement are also critical components in the transition to successful community energy planning. These are well studied areas and the choice has been made to instead focus this paper on the facilitation role of the planner with the private sector – a less studied research area.

While exciting European initiatives abound (for example, Germany is a world leader in solar and wind technology, Denmark in district energy) research for this paper is limited to relatively recent English-language publications. Further, this paper's focus is skewed to environmental energy planning thereby omitting important engineering literature investigating new technologies, their feasibility, effectiveness and economic viability. From my Enbridge internship and previous business experience I realize the importance of collaboration with engineers and technical specialists and these research needs may become the basis for future papers. Lastly, since the private sector has the means and will benefit from environmental

improvements, it is my conviction that the private sector should be involved in sustainable community initiatives working with governments to help rethink our society's current energy paradigm and to help implement new infrastructure.

2: Methods and Methodology

Three research methods were used for collecting the information necessary for this research paper: literature review, content analysis of policy and planning documents and an analysis of a local case study. The methodology began with extensive readings on key concepts of the topic such as sustainability, sustainable communities, energy technologies, generation and distribution in Ontario, the current reality of energy mix in Ontario, the OPA IPSP and their consideration of conservation and renewable energy.

2.1 Research questions

Three overarching questions directed the research for this paper. These broad questions were designed to further the understanding of sustainable community energy planning and then be applied to the Sustainable Pickering case to assist them in implementing their Local Action Plan.

1. What are the opportunities and constraints of using community energy planning (CEP) for creating sustainable communities?
2. What can we learn from Pickering's sustainability journey with regards to using CEP to create more sustainable communities?
3. What needs to be done towards achieving our goal of using community energy planning to create sustainable communities?

These three overarching questions also imply three additional questions used to guide analysis:

1. How can a municipal approach be an effective approach?
2. How must the role of the planner evolve to further the efforts of communities to achieve a goal of using community energy planning to become more sustainable?
3. How can the planner work with utilities and business to convince these energy providers to become more environmentally conscious and participate in the CEP process?

2.2 Research Goal

The research conducted in this research paper is a combination of applied research and formative evaluation with the goal of this research being exploratory. Exploratory research will provide a better understanding of the CEP process, the approaches of other communities, how they have implemented CEPs and aid in understanding why CEP should be pursued. It may also lead to identifying further research topics that may be needed to develop more effective CEP processes for municipalities in Ontario and Canada.

This paper uses applied research through a case study of the City of Pickering that analyses their sustainability approach. This necessitates a clearer understanding the FCM/ ICLEI process and government policies that are driving Ontario towards a "culture of conservation", more energy efficiency, implementation of renewable energy sources and that are promoting municipalities to participate in the provision of energy for their local needs. The purpose of this analysis is to distill some key lessons that will assist Pickering in the implementation of its Local Action Plan to thereby complete Milestone Four of the FCM program. As this is not an easy process Pickering is interested in how other communities have achieved this milestone and how they may best approach the implementation process.

Hart (2003, 46) defines formative evaluation as research designed to make improvements to a specific program, policy or set of activities at a specific time and place and with a specific group aiming to focus the research, using case-study and qualitative evidence. Formative evaluation is selected here with the intention of assisting Pickering to implement their LAP and complete milestones four and five.

2.3 Literature Review

The literature review investigates the main components of the topic: sustainability, sustainable communities, current energy regime in Ontario and theories of alternative energy paradigms and technologies. The review begins by identifying the link between energy and sustainable communities, the various theories of sustainability and sustainable communities, the various ecological schools of thought, the link between planning and sustainable communities and then considers how the implementation gap may be closed.

2.4 Content analysis of policy and planning documents

Ontario planning regime documents (such as the PPS, *Planning Act*, and Official Plans) and energy provision documents (such as the IPSP and *Energy Conservation Act*) were reviewed to understand the foundation of our legacy system and what it is that we are trying to change and why. Reports by leading NGOs (such as Pembina Institute, David Suzuki Foundation and Worldwatch Institute) were also reviewed to gain expert insight into better approaches.

The methodology for this section involved analyzing key policies, acts and planning documents, searching for areas of intersection and diversion of pertinent points (i.e. gaps) between planning and energy. A snowball method (as used in the literature research) was used,

first visiting websites, reviewing conference papers and presentations and by searching the home-page portals of organizations and their related sites. Government Acts and legislation were downloaded from the Government "e-laws" website[1].

2.5 Case Study

This section considers the case study of the City of Pickering's sustainability journey that is following the Federation of Canadian Municipalities (FCM) Partners for Climate Protection (PCP) framework, locating it within the FCM model as well as situating it within the larger literature. At present, FCM recognizes Pickering as having completed the first three milestones (base-lining emissions, setting emissions targets and creating a Local Action Plan or "LAP"). The City is now working on completing milestone four – that is, implementing the LAP and it is interested in learning from other municipalities. Therefore, successful examples of LAP implementation, alternative techniques and new paradigms are included in this section. In addition, this section considers how a utility such as Enbridge may partner with the City, what its role might be in implementing the LAP and how planners might facilitate this process.

The case study methodology involved an extensive search of the City of Pickering's various websites where recommendations to Council are posted along with Council resolutions, workgroups' minutes of meetings, public forum workshop outputs and some key third party consulting research commissioned by the City. It analyzes the journey's origins, evolution, agenda, timelines, current status, targets and proposals as to how targets will be achieved.

[1] These are available at: http://www.e-laws.gov.on.ca/index.html

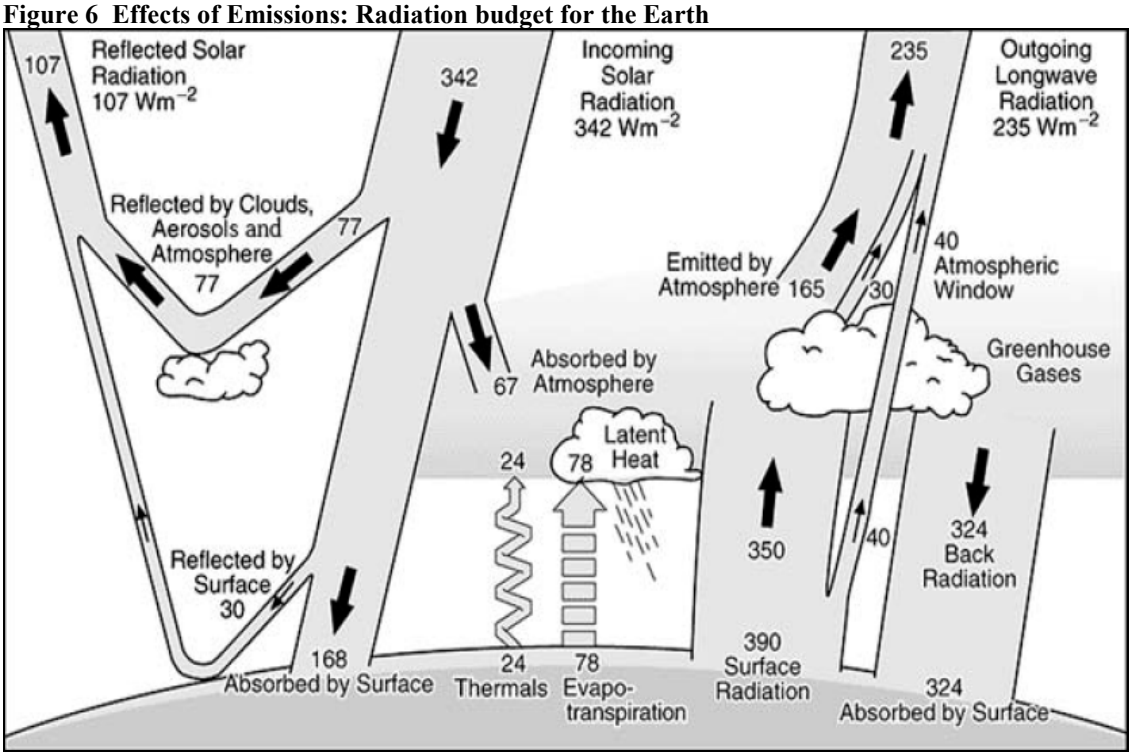
3: Literature Review

3.1 Link 1: Energy and Sustainable Communities

3.1.1 Energy is the Integrator

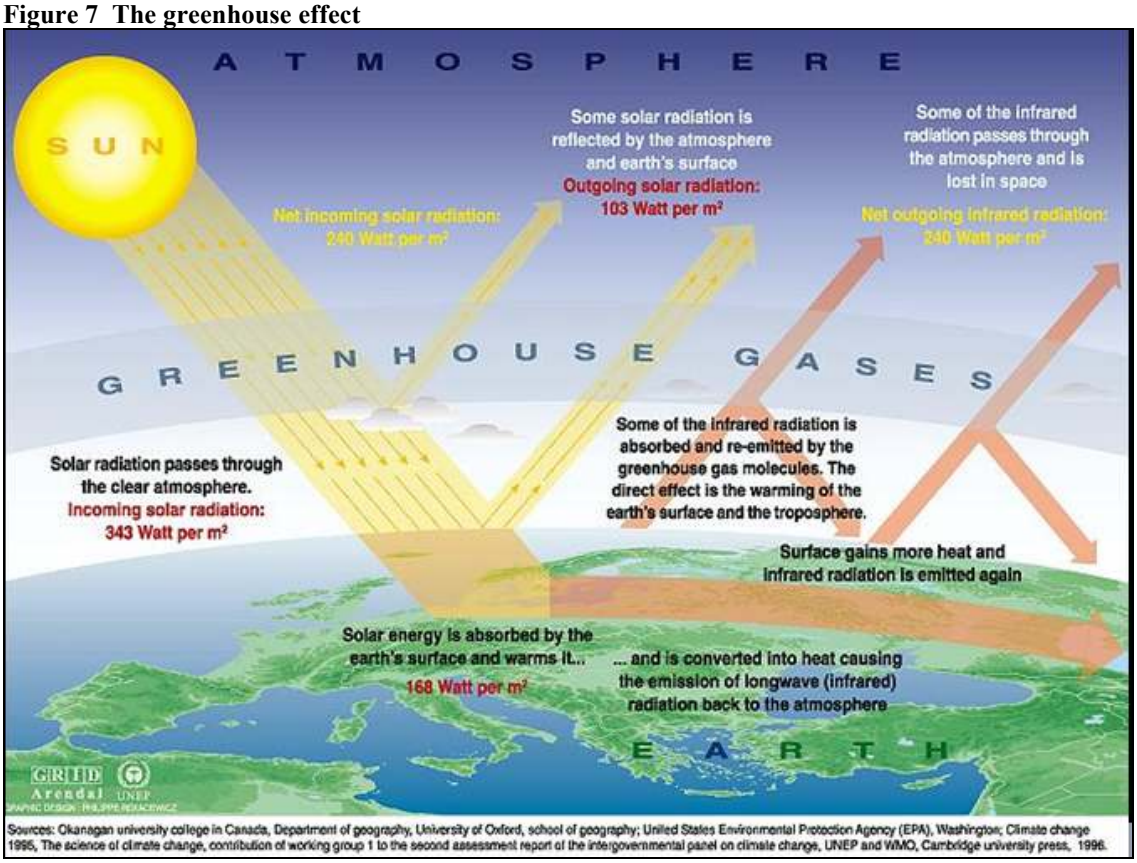
Environmental degradation caused by energy use has occurred throughout history from wood burning contributing to deforestation, to fossil-fuel use contributing to climate change and pollution. Vob (2006) states that considerations of the energy supply system are directly associated with a range of catastrophes including the destruction of the natural resource base for life and to the human-made destabilization of the earth's climate. Energy is a key consideration in discussions of economic, social and environmental dimensions of sustainable development (Porcher 2006, Midilli, Dincer and Ay 2006, Dincer 1999). Sumi states that climate change is not only an issue of interaction between the natural and social systems but is strongly connected to the energy issue, and energy is one of the key elements of modern society. He refers to these issues collectively as a 'trilemma' or 3E (Energy-Economy-Environment) problem (Sumi 2007, 70), notes that "the climate of the Earth is determined by the law of conservation of energy" (Sumi 2007, 69) and asserts that anthropogenic activity has the potential to disturb this energy balance. He scientifically diagrams how heat from solar radiation is received by the Earth then is emitted back in Figure 6. This central relationship is also known as the greenhouse effect and is depicted in a more illustrative manner by Grid Arendal, UNEP in Figure 7.

Figure 6 Effects of Emissions: Radiation budget for the Earth



Source: Sumi 2007, 69.

Figure 7 The greenhouse effect

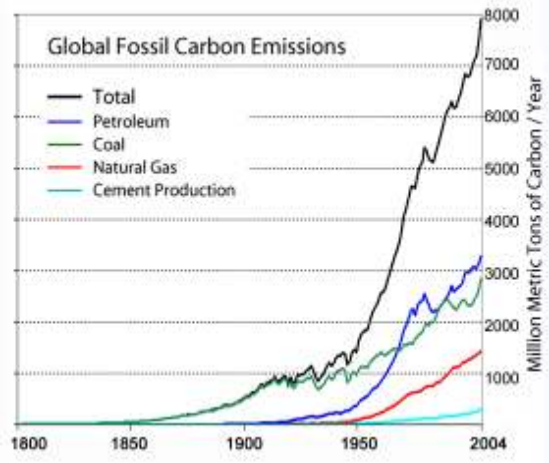


Sources: Okanagan university college in Canada, Department of geography, University of Oxford, school of geography; United States Environmental Protection Agency (EPA), Washington; Climate change 1995, The science of climate change, contribution of working group 1 to the second assessment report of the intergovernmental panel on climate change, UNEP and WMO, Cambridge university press, 1996.

Source: Grid Arendal, UNEP.

Vellinga (2000) asserts that managing the risks of climate change requires a major transformation of the way energy needs are met – including changes in consumption and the production system. Significantly, today's energy system consumes the major share of finite fossil resources and the consumption of fossil-fuels has increased more than 20-fold in the past 100 years. Three-quarters of anthropogenic emissions of CO_2 are released by the energy system (see Figure 8), and what was locally-based human environmental impact has become global impact (Vob 2006, 153). Globally, according to Vob, "slightly more than one billion people in the industrialized counties (about 20 per cent of the world's population) consume nearly 60 per cent of the total energy supply whereas the five billion people in developing countries consume the other 40 per cent of total energy supply" (Vob 2006, 154) (see Figure 9).

Figure 8 Global carbon dioxide emissions 1800 - 2000

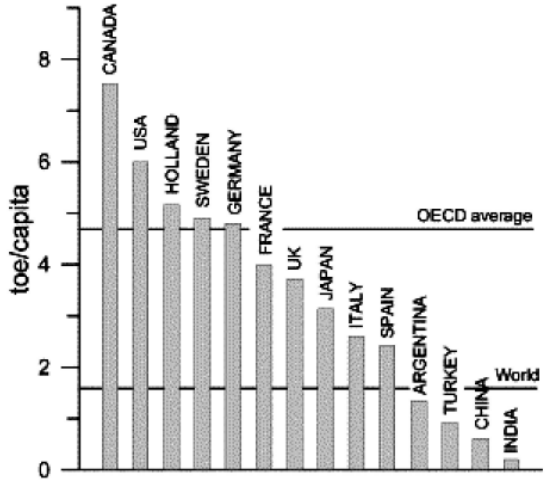


Source: Thorpe 2008.

Figure 9 illustrates Canada's high per capita energy consumption pattern which is unfortunately leading to our growing "energy hog" reputation (Gardner 2008, 3). Additionally, Figures 10-11 illustrate Canada's high GHG per capita emissions and the sectoral breakdown. While Khan *et al.* (2007, 354) explain that this level of emissions is largely due to energy needed

for "heating during severe winters, travel between distant regions of the country, and for the processing of natural resources" there is no justifiable reason why this trend must continue given the sustainable energy options available.

Figure 9 Per capita energy consumption by country 1980 – 2003



Source: Jean-Baptiste and Ducroux 2003 in Khan 2007, 353

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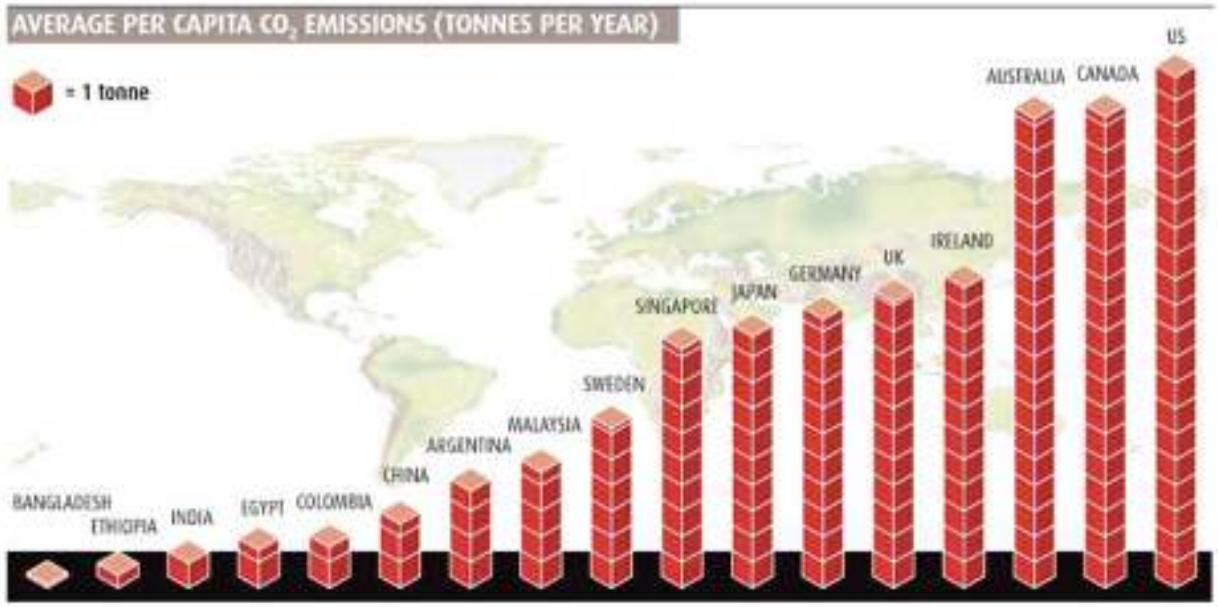
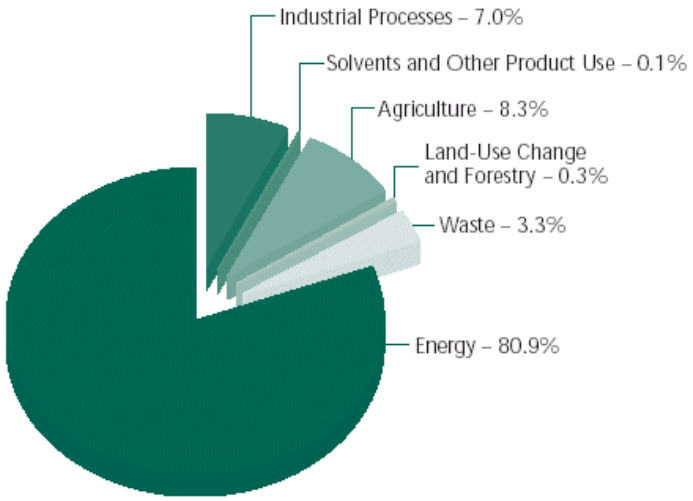
Figure 10 Average per capita CO_2 emissions (tonnes per year)



Source: Etcheverry 2008 FES Climate Change class presentation 2008, from Scientific American.

Figure 11 Sectoral breakdown of Canada's GHG emissions, 2000



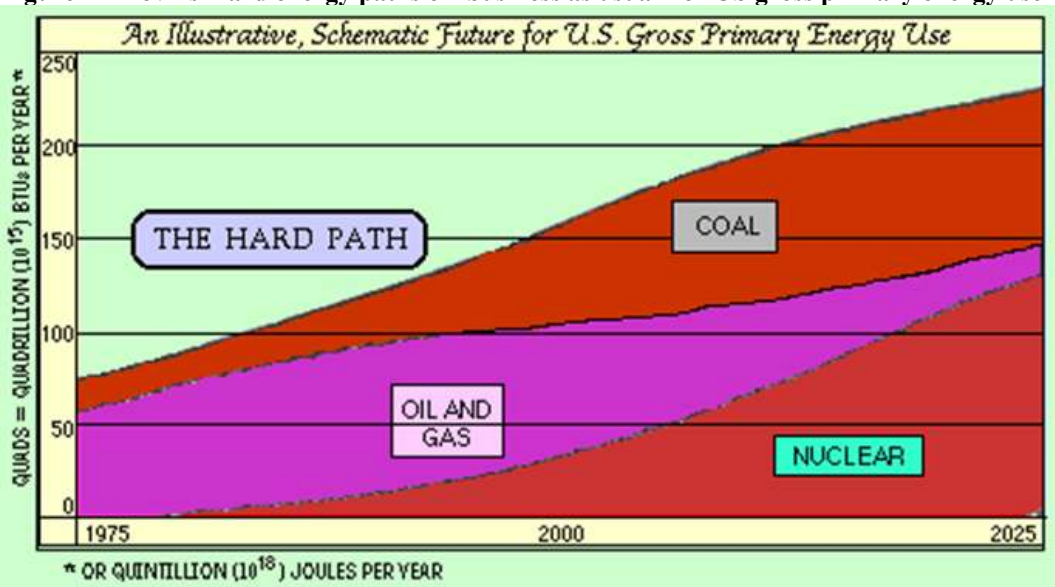
Source: Government of Canada website:
http://www.ec.gc.ca/pdb/ghg/inventory_report/1990_00_report/images/figure1b_e.gif

3.1.2 Sustainable Energy

Many international forums have focused on energy issues – the Rio Summit (1992) and Johannesburg (2002) and while attendees agree that energy issues are central and integral to sustainable development, they disagree with respect to targets, strategies and implementation plans. Academic research too has focused on energy issues and while we have progressed over the last 30 years, Lovins' seminal text *Soft Energy Paths* (1977) is worthy of mention. In it Lovins promotes a decentralized generation and distribution system using 'soft energy' devoid of nuclear generation. Lovins' hard energy paths (or 'business as usual' (BAU)) as illustrated in Figure 12 involves centralized electricity-generating facilities that either burn fossil fuels or harness a fission reaction, but which both incur electricity wastage and transmission loss. Importantly for Lovins soft and hard energy paths are divergent and mutually exclusive. Similarly Dincer and Rosen (2005) clarify that fossil-based energy (coal, petroleum, natural gas)

is not renewable, has negative effects including human health problems and is not sustainable due to their finite nature.

Figure 12 Lovins' hard energy paths or 'business as usual' for US gross primary energy use

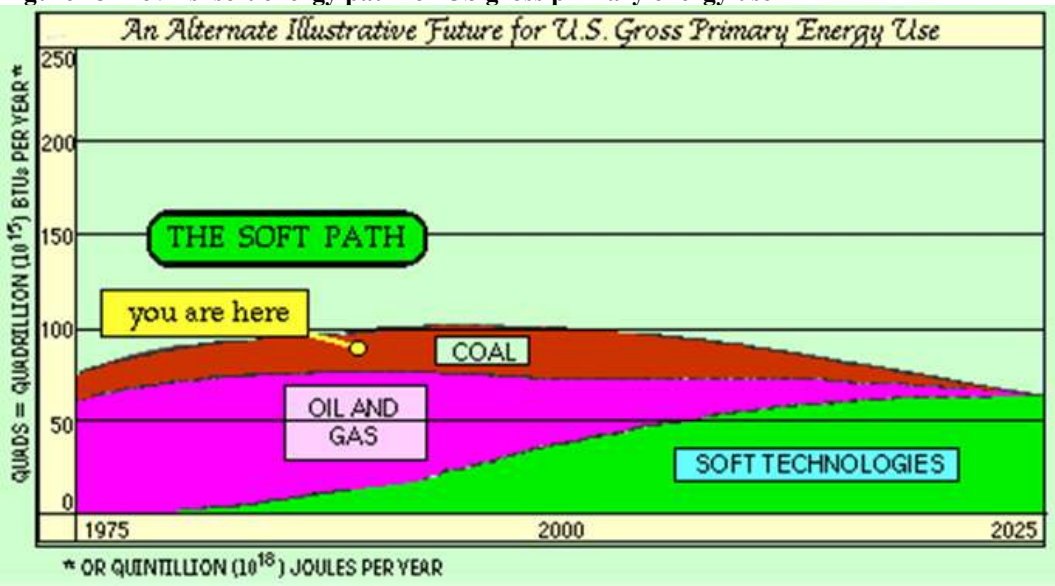


Source: Lovins 1976.

In contrast, soft energy paths (see Figure 13) involve efficient energy uses, diversity of energy production methods (matched in scale and quality to end uses), and rely on soft energy technologies. These renewable energies harness solar, wind, biomass[2] and geothermal sources, are flexible, sustainable and benign, and constitute a diverse energy supply. Lovins notes that soft technologies, through appropriate scale and fit to end-use, achieve greater economies than large, centralized systems in five ways: reducing and sharing overheads, eliminating fuel costs, minimizing distribution losses, reducing diseconomies of scale and benefiting from mass production.

[2] Biomass is defined as "organic material produced by plants or any conversion process involving life" (Strathcona presentation 2003, 11).

Figure 13 Lovins' soft energy path for US gross primary energy use



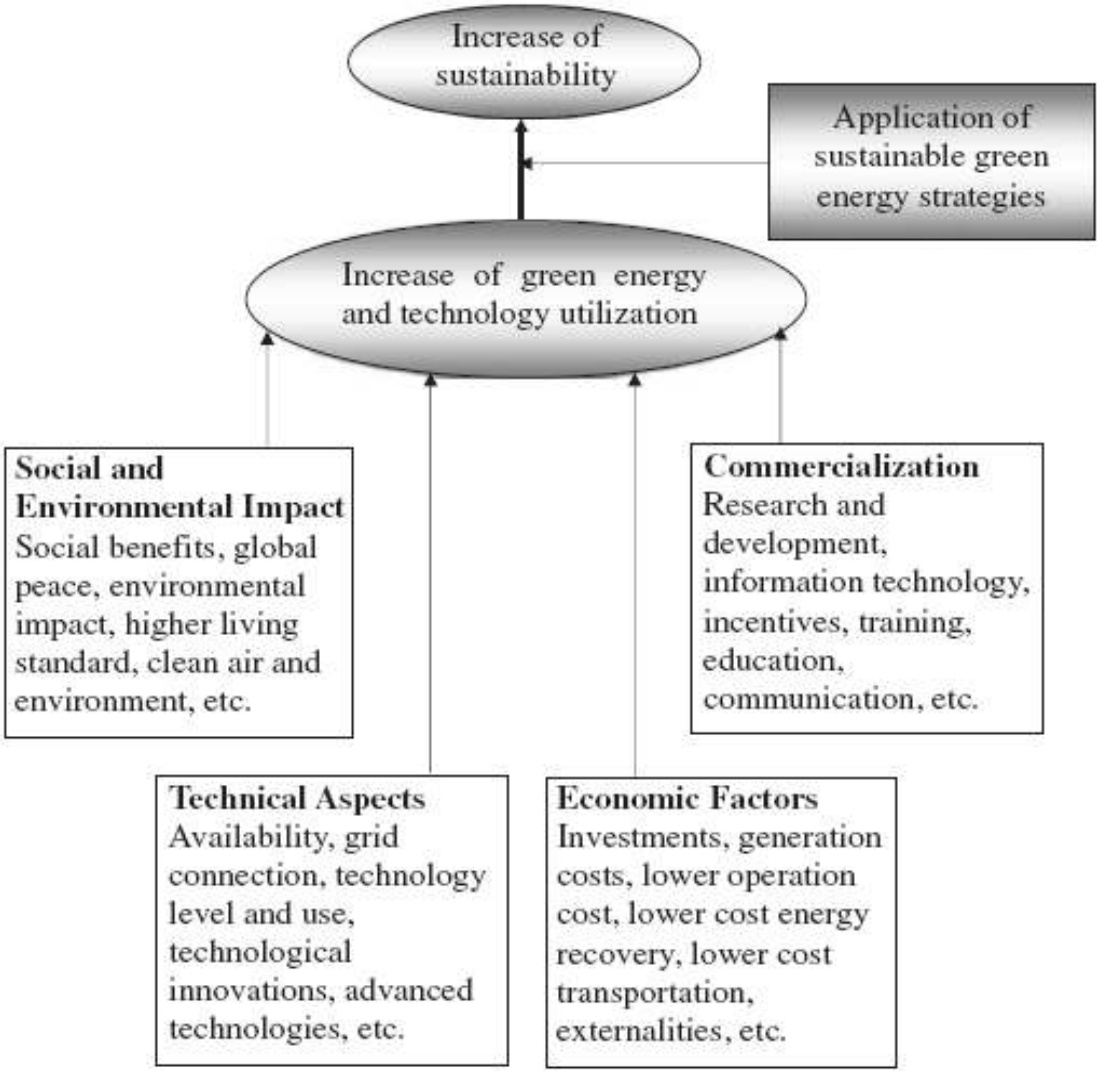
Source: Lovins 1976.

Different approaches for mitigation and adaptation have been presented for achieving sustainable energy. Vob and Cameron, for example, illustrate different underlying assumptions: Vob takes a technological approach while Cameron takes a more environmental approach. Vob (2006) considers the meaning of sustainable development and its direct links with energy systems. Firstly, the second law of thermodynamics is that "life and the inherent need to satisfy requirements is vitally connected with the consumption of workable energy and available material" (Vob 2006, 155). The need to limit ecological burdens and climate change can be substantiated but Vob questions if finite energy resources are compatible with the concept of sustainable development or if by definition, only renewable energy or resources should be considered. Secondly, the state of technology needs to be considered if we are to bequeath to future generations a resource base which is technically and economically useable. Thirdly, the environmental pollution dimension is important and we need to consider decoupling energy consumption with environmental pollution. As Vob notes, it is not always the "use of the working potential of energy which pollutes the environment but the release of substances

connected with the respective energy system" (Vob 2006, 157). To Cameron (1991, 71) a sustainable energy future means one based on renewable energy supplies, however he notes there are major differences of opinion on the opportunities for energy conservation in the current system, and on the rate of transition from fossil fuels to renewable sources. Sumi (2007) points to the value systems of people as a significant factor in the effort to establish a sustainable society.

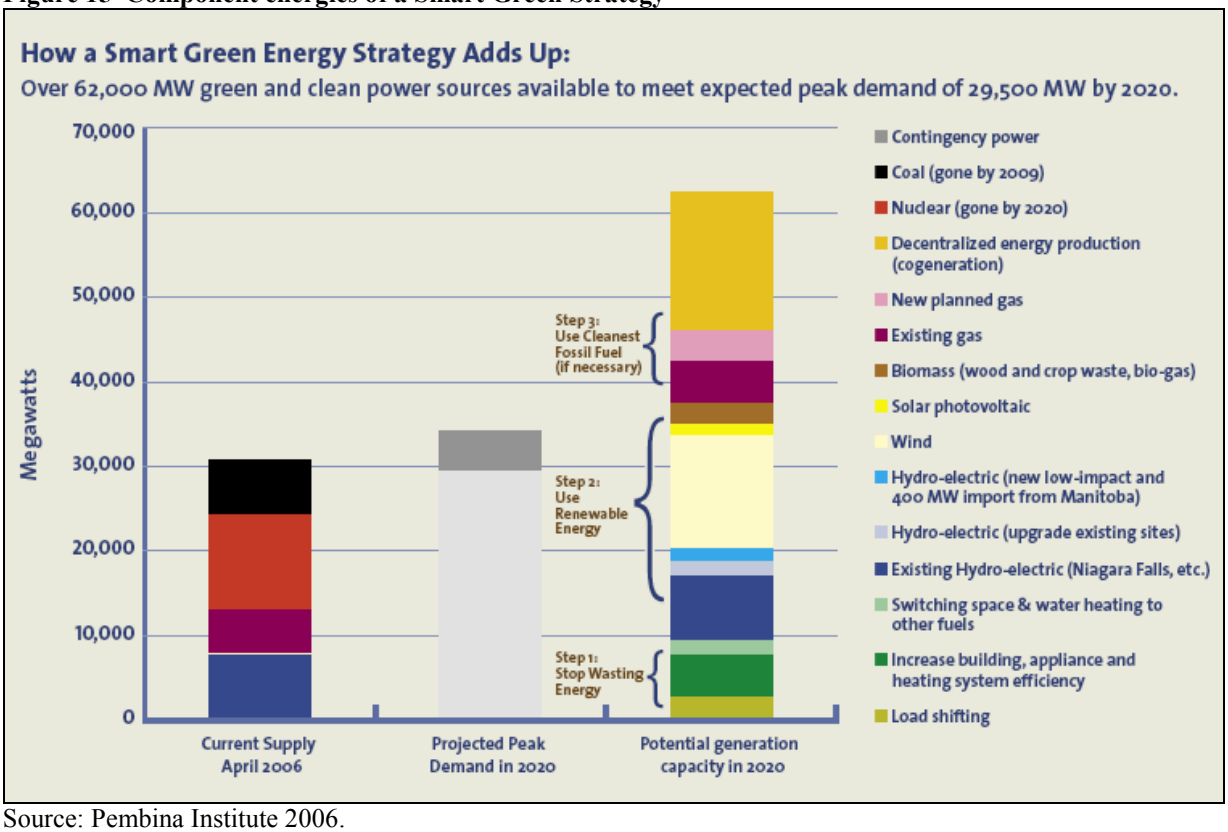
Midilli, Dincer and Ay's (2006) study investigates how green energy technologies can be developed for a sustainable future. Similar to Lovins soft energy, they note that green energy resources and technologies cause less environmental impact, cannot be depleted, and favor system decentralization and local solutions. Figure 14 illustrates the various factors and influences involved in developing a green energy strategy for sustainable development. Figure 15 illustrates Pembina's vision of a smart green energy mix for Ontario.

Figure 14 Developing green energy technologies for sustainable development.



Source: Dincer and Rosen 2005, cited in Midilli *et al* 2006, 3625.

Figure 15 Component energies of a Smart Green Strategy



Source: Pembina Institute 2006.

3.1.3 Sustainable Community Energy Planning (SCEP)

The design of communities fundamentally affects, and is affected by, the use of energy. As an emerging concept, many researchers have termed SCEP differently: community energy management (CEM), community energy systems (CES), community energy planning (CEP). This paper considers these terms to be interchangeable as all consider energy supply, demand, development, generation and distribution with the goal to create more environmentally, socially and economically sustainable communities. SCEP engages local government and citizens in the management of energy supply and use and can benefit municipalities as detailed in Table 1.

Table 1 Porcher: Benefits of energy planning

- Greenhouse gas reduction
- Healthier and more livable communities
- Efficient communities
    - Habitat and agricultural land preservation
    - Reduced travel times
- Economic development and energy security
    - Reduced energy costs
    - Job creation – new energy and efficiency businesses
    - Keeping energy dollars local
    - Long-term energy security
- Demonstrating leadership and self-reliance

Source: Porcher 2006.

This section considers four explanations by leading proponents to provide further insight as to what a SCEP vision entails: West Coast Environmental Law, Porcher, Sadownik and Jaccard, and CMHC. West Coast Environmental Law (website) states that Sustainable Community Energy Planning (SCEP or CEP) is

> "emerging as one comprehensive planning tool that helps municipalities to understand how the use and delivery of energy affects community goals as diverse as paying for new infrastructure, managing growth, preserving watersheds, controlling air pollution, and dealing with traffic congestion. CEP complements and reinforces other *smart growth* planning by demonstrating how creating compact complete communities also decreases energy costs".

Porcher (2006) defines community energy planning (CEP) as the consideration of energy supply and demand in community design and development and notes that it has four pillars: design (land use and transportation), buildings (site planning, green buildings and retrofits), infrastructure and alternative energy supply options. As three of the four are traditional planning functions and since municipalities have been invited by the Ontario Government to consider energy planning in their communities, it is not a far stretch to see CEP as a planning function to include consideration of energy.

Sadownik and Jaccard (1999, 55) define community energy management (CEM) as a "sustainable energy strategy which looks at how purposely shaping the built environment and designing urban services in consideration of energy production, distribution and use could affect both the long-term demand for energy and the type of energy supplied." Sadownik and Jaccard (1999, 55) conclude:

> "in seeking ways to minimize the environmental impacts of energy use, countries have begun shifting the focus in energy development towards planning in relation to the end use demand for energy, primarily at a technology use rate, technology and building scale. A further focus has been to examine how purposely shaping the built environment and designing urban services in consideration of energy production, distribution and use, could affect the long-term demand for energy and type of energy supplied. This approach has loosely been termed, 'community energy management' (CEM). It is based on the premise that a significant proportion of future energy consumption is predetermined when land use and urban form is designated. It is directed at residential, commercial and urban transportation energy use."

Municipalities can promote CEP through their land use and transportation planning procedures, building codes, bylaws, and municipal investments in infrastructure. As Tables 2-3 illustrate these proponents share similar visions as to what constitutes SCEP.

Table 2 Sadownik and Jaccard: CEM scenario

Area	Strategies
▪ Land-use planning	
	▫ Land-use planning control resulting in more coordinated development
	▫ A tendency towards mixed land use and the maintenance of dispersed business centres
	▫ A tendency towards mainatining a relatively high density, but not to the detriment of local environmental quality
▪ Site and building design	
	▫ Building to maximize the shape coefficient
	▫ Ensuring that buildings are built so that they fan be easily and economically retrofitted for district heating and/or cooling
▪ Energy supply and delivery systems	
	▫ The replacement of decentralized and uncontrolled coal combustion in individual apartment blocks and dwellings.
	▫ Encouraging the interaction of industrial energy provision with residential uses.
	▫ A faster introduction of new fuels and tecnologies (such as district cooling, waste heat).
	▫ Increased gas penetration for cooking and heating.

Source: Sadownik and Jaccard 2001, 57.

Table 3 West Coast Environmental Law: CEP

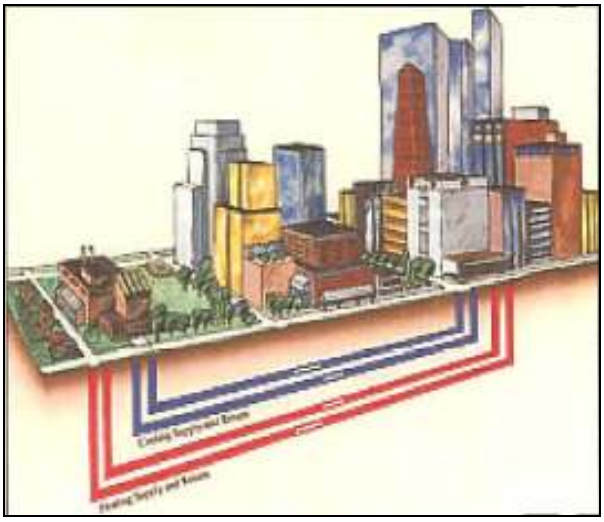
Area	Strategies
▪ Land-use planning and transport	
	▫ To develop compact complete land use patterns where a variety of uses are mixed to increase alternatives to automobile. Strategies include contiguous development patterns, parking plans and siting, street design, and stakeholder participation.
▪ Site planning and building design	
	▫ To increase the use of design to iprove energy performance. Strategies include building and appirance efficiency, solar orientation of buildings, landscaping, wind shielding and shading, pedestrian facilities and orientation, and transit facilities and orientation.
▪ Infrastructure efficiency	
	▫ To increase the use of energy-efficiency of infrastructure, and to increase the production of energy from regional or munipal facilities. Strategies include water supply and use, wastewater collection and storm drainage, recycling facilities, heat and power recovergy, and joint infrastructure planning and delivery.
▪ Alternative energy supply	
	▫ To increase local and high efficiency energy supply options. Strategies include "district" heating and cooling, waste heat utilization, heat pumps, co-generation of heat and power, wood-waste systems, solar technologies, and alternative fuels.

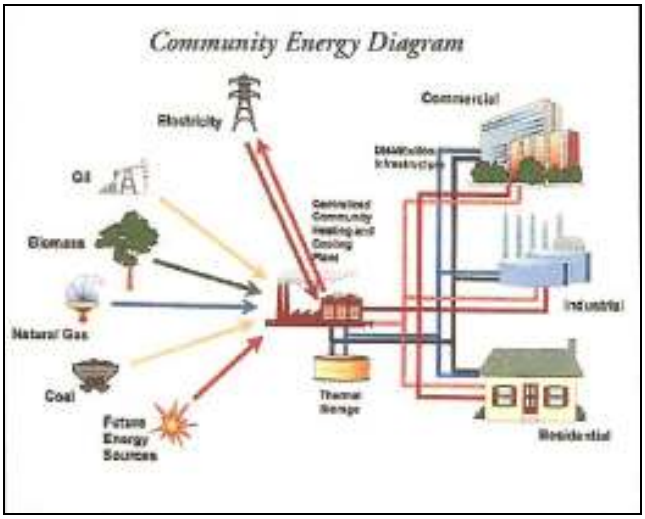
Source: West Coast Environmental Law website.

Similarly, the CMHC notes, “CEM typically addresses the following aspects of urban planning and development: land use planning – zoning for specific land uses, land use densities and land use patterns; transportation management – traffic management, developing high-

occupancy vehicles, transit, walking and bicycling infrastructure and services; site design – encouraging designs that improve the economics of energy efficiency measures, alternative energy supply technologies, use of passive solar energy and microclimatic considerations; and energy supply and delivery systems – district energy systems using, in some cases, renewable or waste energy" (CHMC 2003). A community energy system (CES), or district energy system (DE) as illustrated in Figure 16, "supplies heating, cooling and power to multiple buildings from a centralized plant or from several interconnected but distributed plants" (NRCan, CETC).

Figure 16 Sustainable Community Energy Systems





Source: NRCan/CETC/CANMET leaflet.

3.1.4 Section Summary

Although various definitions, acronyms and techniques for achieving more sustainable communities exist, each vision presented in this section includes energy as a central component in urban design. Planners as stewards of cities are well poised to integrate energy solutions into

their planning functions, initiatives and plans. Municipalities have much to gain by incorporating innovative energy solutions to help create more sustainable communities.

3.2 Foundational Concepts

3.2.1 Sustainability: Origins, Diverse and Contested meanings

Sustainable development is "a process of social and economic betterment that satisfies the needs and values of all interest groups, while maintaining future options and conserving natural resources and diversity" (IUCN 1980). Further, they continue, it improves "the quality of human life while living within the carrying capacity of supporting eco-systems."

The concept of sustainability is not new. O'Riordan (1989) notes that it can be traced back 2,000 years to the Greek vision of 'Ge' or 'Gaia', the goddess of the Earth, the mother figure of natural replenishment. Etymologically, 'sustainable' derives from its Latin root *sustenere* meaning to hold up or keep elevated. Definitions of "sustain" vary from **"**to continue without lessening, to nourish, to allow to flourish" (Hart 1999) to "cause to continue (as in existence or a certain state, or in force or intensity); to keep up, especially without interruption diminution, flagging, etc.; to prolong" (Merriam-Webster 1986). In the context of energy it means to "maintain or prolong the productive use of resources and the integrity of the resource base" (Satia and Hansen 1994, 1). 'Develop' is defined as "to bring out the capabilities or possibilities of, to bring to a more advanced or effective state" (Hart 1999, Random House 1987) however, no consensus of what this means in practical terms exists most likely due to the fact that the term is value-laden.

In the 1980s environmental geographers began attaching the concept to the phenomenon of urbanization and variations such as "sustainable cities", "sustainable communities" and

"sustainable urban development" emerged. As defined by the 1987 Brundtland Report "sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED 1987, 8). The WCED (1987) identifies nine operational objectives of sustainable development: "reviving growth, changing the quality of growth, meeting essential needs for jobs, energy, water, and sanitation, ensuring a sustainable level of population, conserving and enhancing the resource base, reorienting technology and managing risk, merging environment and economics in decision making, reorienting international economic relations, and making development more participatory" (WCED 1987 in Jacob 1994, 483). (See Appendix A for a summary of sustainable development milestones).

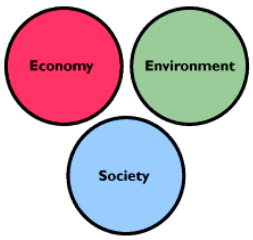
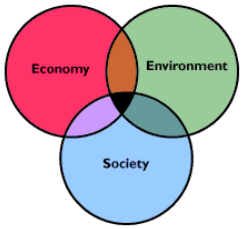
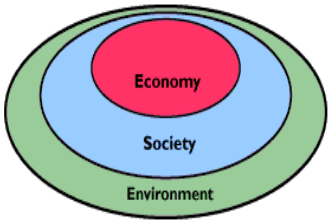
However as Mikolajuk and Yeh (2000) note, "no single term or definition can define the concept of sustainable development precisely". Fowke and Prasad (1996) have identified at least 80 different, often competing and sometimes contradictory operational definitions (Fowke and Prasad 1996 cited in Williams and Millington 2004, 99). The concept includes both eco-centric and anthropocentric (human-nature system) viewpoints. Critically, Thring regards the term "as an oxymoron, arguing that development per se cannot be sustainable" (Thring in Doughty and Hammond 2004, 1224) and O'Riodan (1989), notes "sustainability appears to be accepted as the mediating term designed to bridge the gap between developers and environmentalists, each using the concept to justify their proposed actions" (Satia and Hansen 1994, 1). While the Brundtland and IUCN definitions may not be preferred by environmentalists, they are the most universally accepted and used. Understanding these terms, agreeing on a common consensus of what they mean individually and communally is important when communities decide to set goals and take action to achieve their goals. Porritt stresses that at best development "is only a process or

journey towards a destination: 'sustainability'" (Porritt in Doughty and Hammond 2004, 1224). In this paper, the term is used to denote a movement towards lowering GHG emissions.

3.2.2 Sustainable Communities: Think Global / Act Local

Seymoar (2008) comments that, "a sustainable city enhances the economic, social, cultural and environmental well-being of current and future generations". To Sustainable Seattle, sustainability is the "*long-term*, cultural, economic and environmental health and vitality … together with the importance of linking our social, financial, and environmental well-being" (Hart 1999) – the three tenets of sustainable development as illustrated in Figure 17. As Brown (2008, 141) states sustainable development is "development that satisfies the 'triple bottom line' of providing economic benefit while also enhancing the environment and society".

Figure 17 Venn diagram illustrating the triple bottom line concept of sustainability

		
View of community as three separate unrelated parts.	A view of community that shows the links among its three parts: economy, social and environment.	Concentric circles where economy exists within society and both, economy and society exist within the environment.

Source: Hart 1999.

Urban communities are expanding exponentially around the world and are the major consumers of energy. Rogers (1997) predicts three-quarters of the world's population may live in urban communities by the year 2025. Closer to home, Statistics Canada (2005) census data

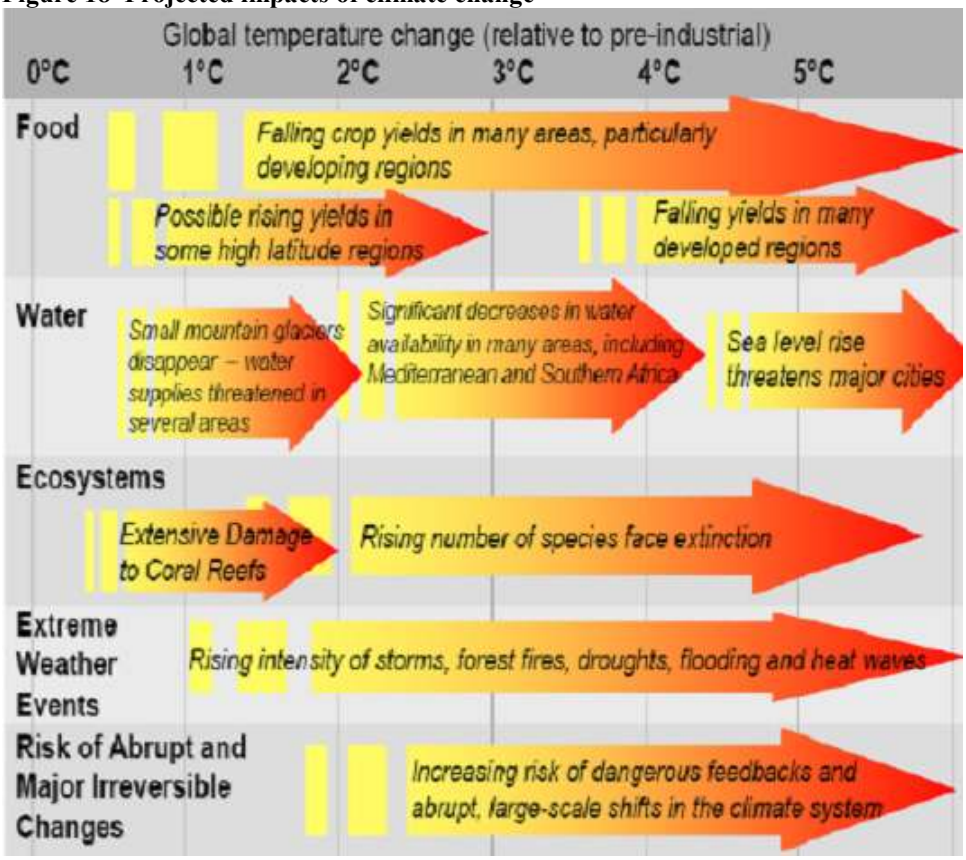
reveals that Ontario's urban-to-rural split shifted from 86% rural in 1851 to 85% urban in 2001. (See Appendix D: Ontario - Urban-Rural Composition Shift for more detail). In the context of sustainability, communities can range from a group of people who live and interact within a specific geographic area, to a small rural community, a large metropolitan region, a nation, or the entire planet. NRCan (2005, 6) notes that a 'community' can take many forms, but for the sake of their SCEP guide it is considered to be:

> "a group of bodies that act together and contain a common theme. Thus a community may be as large as a city; it may be as small as a neighbourhood, or it may be a region that embraces several local areas of population. A community is any area or group with common interests that engages its members. A community is "where we eat, sleep, shop, go to school, go to work, enjoy the outdoors, and get together for mutual activities: it's where we live".

This paper adopts the Statistics Canada definition of community (centres with populations of 10,000+) and recognizes the importance of the community's shared interactions (economic transactions, social relationships and environmental interdependence).

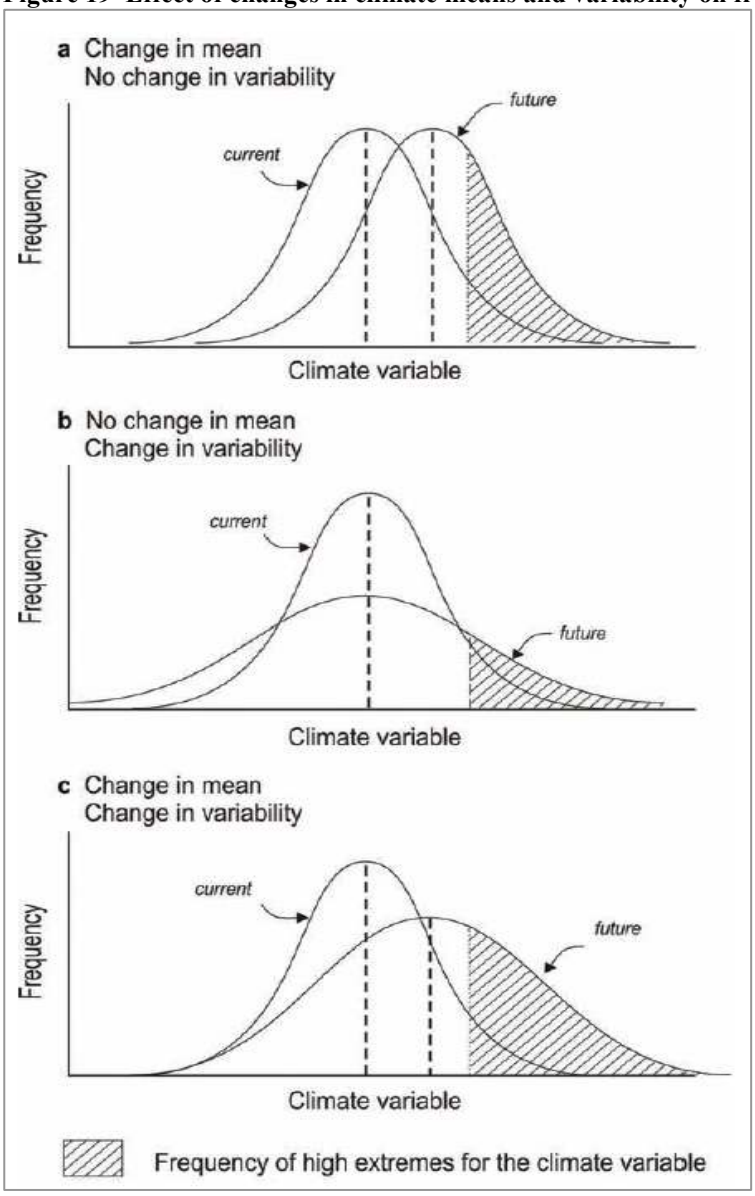
Climate change is as Brown notes "the most prominent example of a transnational environmental security threat" and "environmental protection is a requirement to preserve the earth's life support system" (Brown 2008, 141). Figure 18 presents the projected impacts of climate change on Earth and Figure 19 presents the findings of Smit and Pilifosova (2003) whose work co-relates changes in climate means and variability to anticipated increase in frequency of climatic extremes. As scientists and researchers aptly warn, the time to act on climate change is now and as demonstrated by Roger's trending, this urgency is increasing.

Figure 18 Projected impacts of climate change



Source: IPCC, 2001.

Figure 19 Effect of changes in climate means and variability on frequency of climatic eExtremes.



Source: Smit and Pilifosova 2003, in Burton 2007, 24.

Hill and Mate at NRCan (2005) predict that "the effects of changing climate will be borne in large part by cities and communities." Energy is vital to city well-being but cities are vulnerable and they will be affected by energy-related choices, by GHG emissions, climate change (weather events) and air pollution causing health problems. Medhi (2006, 7) notes that city systems will need to adapt: built systems (infrastructure such as energy transmission lines

damaged in ice storms); natural systems (more extreme temperature variations will mean more demands on energy); and human systems (for health care related to deteriorated air quality from smog and air pollution).

A study conducted by LURA consultants[3] identifies four areas of concern for Ontario: ecosystem health, human health, infrastructure and water resources. Their findings are presented in Figure 20. These concerns include negative effects on wildlife, vegetation and habitats as well as impacts on human health.

Figure 20 Critical Impacts for Ontario Communities

Ecosystem Health	**Infrastructure**
Threats From: Extreme weather events, Ice changes, Lower lake levels, Loss of wetlands, Cumulative impacts **Threats to**: Biodiversity, Land Resources, Management Ability, Water quality and quantity, Air quality	Runoff and landslide impacts (flooding) Water intake/control infrastructure (water quantity) Deterioration of infrastructure (buildings, roads etc.) Damage to Infrastructure (roofs, road, transmission towers etc.) Reduced security of energy supply Design specifications/margin of safety in building codes
Human Health	**Water Resources**
Vector borne diseases Extreme weather – extreme heat and cold Deteriorating Air quality Deteriorating Water quality Secondary impacts e.g. indoor molds, weather related transportation accidents and fatalities Collective/Cumulative impacts	Increased capacity demands on sewage/water control infrastructure Pressures on source water resources Change in pattern of supply (municipal management implications) Social and economic impacts (e.g. tourism, recreation) Degraded water quality

Source: LURA Consulting 2002.

Municipal medical officers of health and the Ontario Medical Association have also raised concerns about the human health impacts of local and regional energy use, particularly in terms of air quality. As noted in Table 4, air pollution (from fossil fuel combustion) led to the

[3] Workshop hosted by Canadian Climate Impacts and Adaptation Research Network (C-CIARN) and led by LURA Consulting with the purpose to "identify key climate change impacts and adaptation issues from the point of view of municipal stakeholders; provide policy and decision-makers with credible information about the vulnerabilities of Ontario's communities to climate change; and to obtain feedback on municipal research priorities" (LURA 2002, 1).

premature deaths of over 1,900 people in Ontario in 2000 and this number is expected to grow by one-third by 2015.

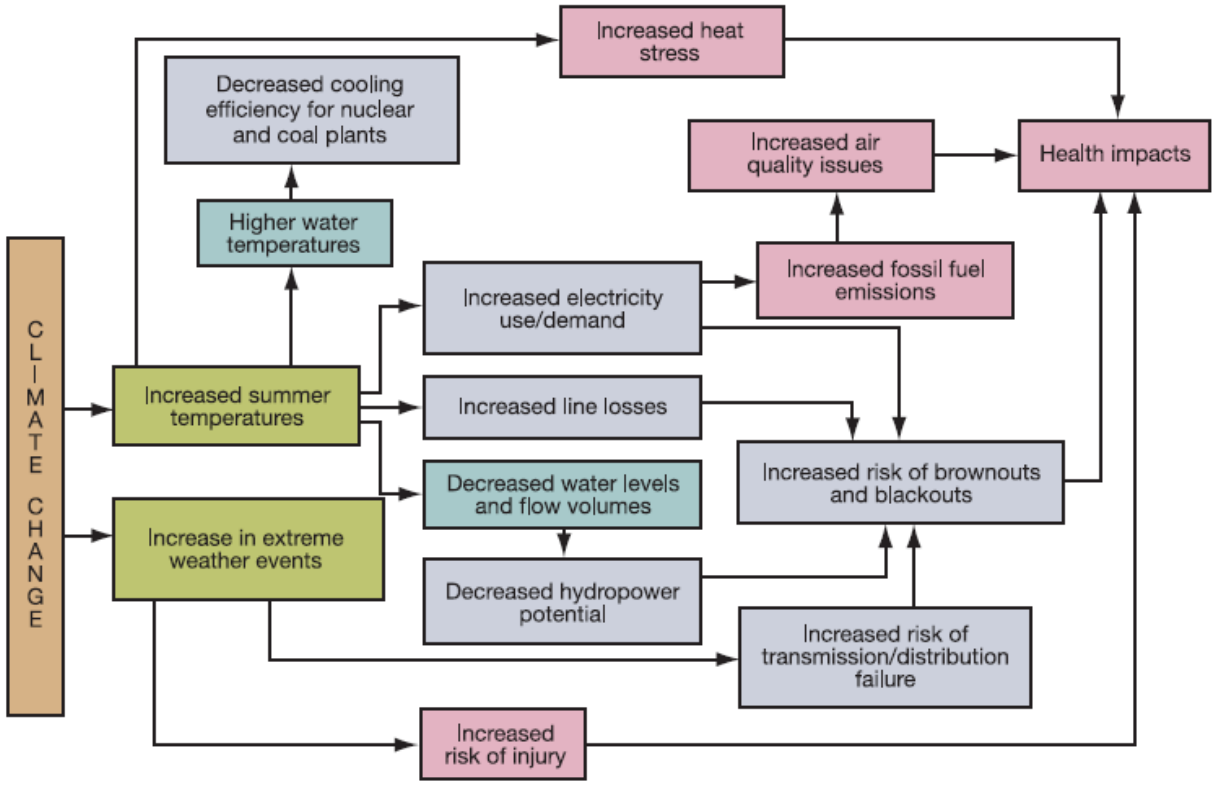
Table 4 OMA: Ontario air pollution health effects and air quality economic damages

Annual Health Effects of Air Pollution	Number of People (Actual 2000)	Number of People (Forecasted 2015)
Premature Deaths	1,925	2,573
Hospital Admissions	9,807	13,052
Emergency Room Visits	13,146	18,592
Minor Illness Days	46,445,663	52,301,976
Economic Damages with Changes in Air Quality	**Number of People (Actual 2000)**	**Number of People (Forecasted 2015)**
Health Care Costs	$601,483,422	$696,296,109
Lost Productivity	$560,856,950	$626,285,032
Increased Pain and Suffering	$4,758,245,353	$5,367,543,466

Source: Ontario Medical Association 2001.

Table 4 also highlights the economic costs associated with poor air quality that run into the hundreds of millions of dollars per year, just in terms of direct health care costs and lost productivity. When the indirect costs associated with pain and suffering are added, the costs were just under $5 billion in 2000. Burton illustrates how climate change can impact human health using an energy example in Figure 21.

Figure 21 Potential impacts of climate change on human health – an energy example



Source: Burton 2007, 11.

3.2.3 Mitigation and Adaptation Strategies

These threats to human health and areas of concern for communities confirm the urgency that Brown states. History has demonstrated that sustainable communities are not what humans naturally create. Development principles and strategies are needed, therefore, to make them sustainable. Table 5 presents Dale's (1994) thirteen principles for developing sustainable communities (development that integrates ecological, social and economic decision-making).

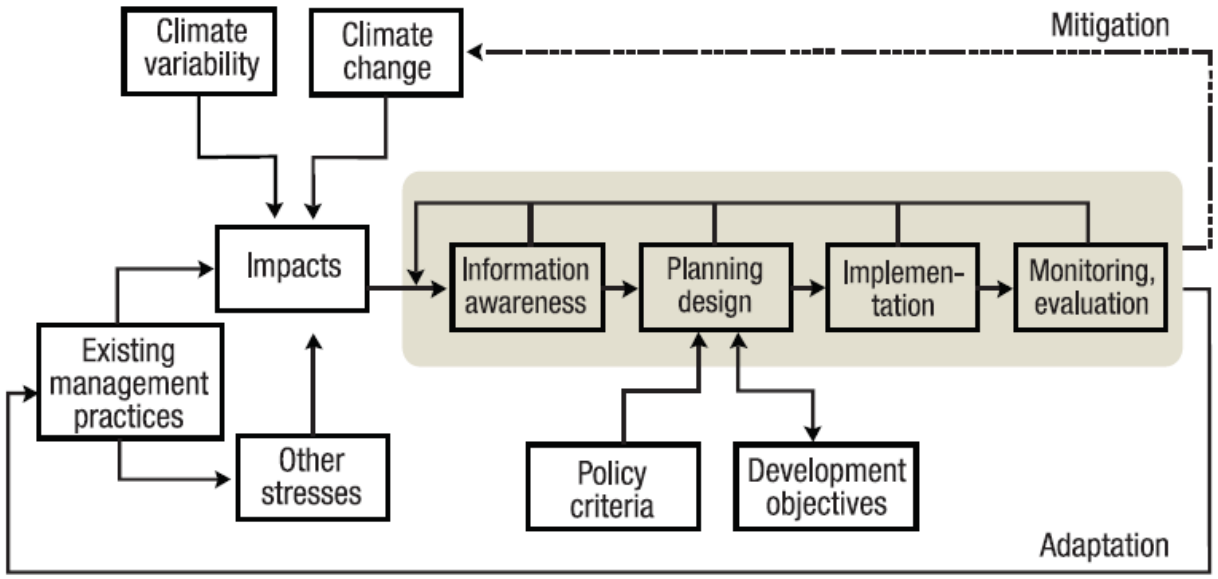
Table 5 Dale: 13 principles for developing sustainable communities

1. The biosphere is a community to which we belong rather than a commodity belonging to us.
2. All species have inherent value in the biosphere.
3. Human beings have stweardship for the quality of water, air and soil of the biosphere.
4. The enthropic throughput of natural resources should reflect their real costs as a factor in production and consumption.
5. The health and well-being of humans and all other species is inseparable from the health and well-being of the biosphere.
6. Development must be in harmony with the environment.
7. Any production that is not sustainable cannot be counted as capital.
8. Optimal allocation of human and natural resources must be in harmony with optimal scale, recognizing the finite limits of the biosphere.
9. Human activity must not be conducted at the irreversible expense of other species and ecosystems.
10. Diversity is integral to a sustainable society.
11. Sustainable development maintains or enhances the integrity of natural resource capital, therefore contributing to the increased well-being of all species.
12. The present generation has an obligation to all future generations.
13. The health of one nation ultimately affects the health of all nations.

Source: Dale 1994.

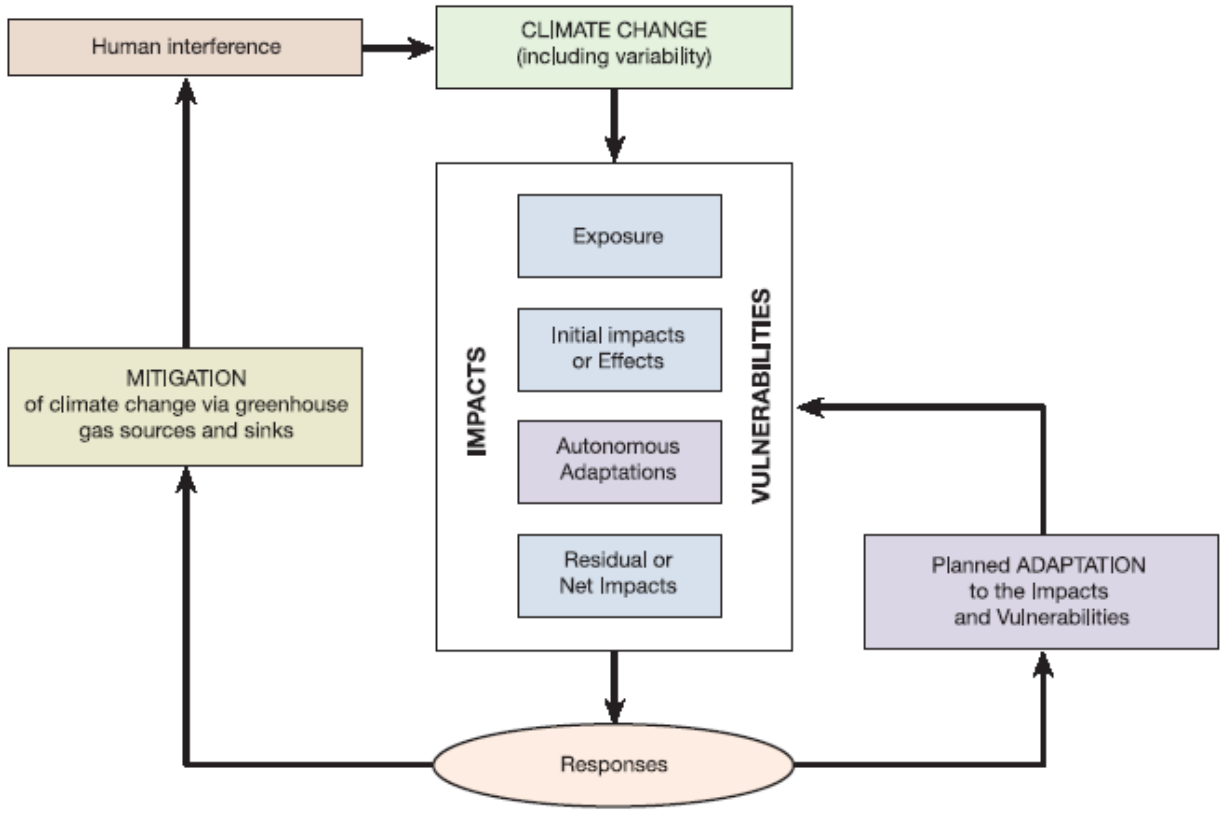
Unfortunately, while Dale's principles are sound, cities have become less sustainable since 1994, rather than more sustainable. More recently the Conference Board of Canada (CBOC) suggests two approaches for communities to take to protect its citizens: mitigation and adaptation. They define mitigation as, "human interventions to reduce the sources or enhance the sinks of GHGs" (CBOC 2006, 31) and adaptation as, "a process by which individuals, communities and countries seek to cope with and reduce the risks and consequences of climate change" (CBOC 2006, 1). Jaccard believes that the prospect of increased atmospheric GHGs can be addressed by mitigation measures to reduce GHG emissions or enhance their removal, thereby reducing the damages from climate change. Jaccard and Montgomery (1996) suggest informative, scientific research and the development of new energy technologies to reduce current uncertainties and provide new cost-reduction technologies. These approaches are illustrated in Figures 22-23.

Figure 22 Steps involved in planned adaptation and mitigation of climate variability and change



Source: Klein *et al,* 2006 in Warren and Egginton 2008, 28.

Figure 23 Adaptation and mitigation in the context of climate change



Source: Smit *et al*, 1999 in Burton, 2007, 22.

3.2.4 Triple Bottom Line Organizations

Recently sustainability discussions have spread to corporate boardrooms and have been published in respected management journals. For example, recently the Harvard Business Review (2007) noted that:

> "we don't know precisely how climate change will alter the planet, but two things are certain: its complex environmental impact will directly affect business, society, and ecosystems; and governments will seek to mitigate its effects with far-reaching regulations. Until recently, companies have for the most part freely emitted carbon, but they will increasingly find that those emissions have a steep price, both monetary and social. As a result, businesses that continue to sit on the sidelines will be badly handicapped relative to those that are now devising strategies to reduce risk and find competitive advantage in a warming, carbon-constrained world."

Furthermore, as Porter and Reinhart (2007) note, "climate change is now a fact of political life and is playing a growing role in business competition. Greenhouse gas emissions will be increasingly scrutinized, regulated, and priced. While individual managers can disagree about how immediate and significant the impact of climate change will be, companies need to take action now." Companies that persist in treating climate change solely as a corporate social responsibility issue, rather than a business problem, will risk the greatest consequences. The detrimental effects of climate change on companies' bottom line operations are now tangible and can no longer be overlooked.

According to Lovins and Lovins (2001) natural capitalism is based on: cutting wastes, increasing profits and slowing depletion of resources and pollution; redesigning the economy on biological lines that close the loops of material flows; shifting the structure of the economy from focusing material processing and manufacture to the creation of service and flow. This would reward resource productivity and loop-closing and reverse the current planetary destruction with

restoration programs investing in natural capital. This strategy calls for business to behave responsibly to nature and people, to increase profits, inspire its workforce and gain competitive advantage.

Elkington (1998) explains that the triple bottom line (TBL) is simply an expansion of the traditional bottom line adding environmental and social net benefits to the net economic benefits of a project. The 1987 Brundtland Report "*Our Common Future"* provided insight into how to integrate economics and environment into decision-making and laid the foundation for TBL thinking. Later, the Stern Report (2007) expanded on this noting the economic disaster that will result if environmental issues are not given priority. Hawken (1993) presents six requirements for business sustainability in Table 6.

Table 6 Hawken: Business sustainability requirements

1. Replace nationally and internationally produced items with products created locally and regionally
2. Take responsibility for the effects they have on the natural world.
3. Do not require exotic sources of capital in order to develop and grow.
4. Engage in production processes that are human, worthy, dignified, and intrinsically satisfying.
5. Create objects of durability and long-term utility whose ultimate use or disposition will not be harmful to future generations.
6. Change consumers to customers through education.

Source: Hawken 1993, 144.

Hart (1999) comments that sustainable development improves the economy without undermining society or the environment and that a sustainable community does not consume resources, such as energy, faster than the natural systems they come from can regenerate them. Linton (2007) asserts that municipalities are inherently triple bottom line oriented organizations concerned with: financial and economic measures (using tax dollars wisely, efficiently and being accountable to the public for their performance, providing jobs, expanding the tax base and creating wealth); the social welfare of their residents (providing social, recreational and cultural

opportunities to meet taxpayers' needs); and environmental issues (including waste management, the encouragement of energy and resource conservation, planning, parks and green space provision, and ensuring green operations for municipal facilities).

3.2.5 Section Summary

As Senator Gaylord Nelson, the Founder of Earth Day noted, we must recognize that "the economy is the wholly owned subsidiary of the environment".[4] If we do not respect our environment we could ultimately find ourselves living in a degraded environment that simply does not provide sufficient resources to support our economies. This is exemplified by Diamond (2007) in his book, *Collapse: How Societies Choose to Fail or Succeed* with the stark example of Easter Island and closer to home by the demise of Canada's cod fishing industry.

In January 2007, Sir Nicholas Stern released *The Economics of Climate Change - The Stern Report* making two invaluable contributions noted by Harding (2006): "the first is that it recasts environmentalism as economics; ... [and the second] is to provide a formula for durable environmentalism, one which binds business and government." This important acknowledgement is essential if we are to stop incurring an ecological deficit.[5]

3.3 Ecological Schools of Thought

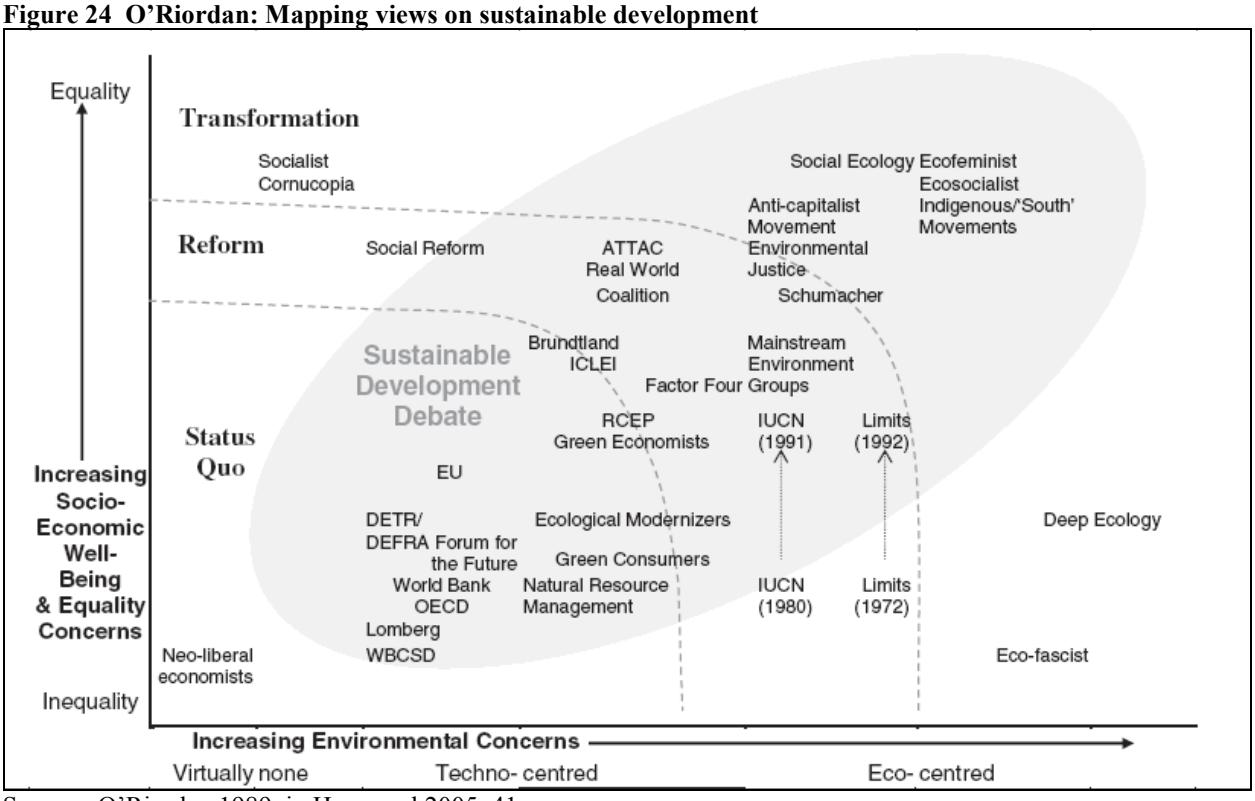
Ecological schools of thought have developed in response to Western tradition, modernist thought and Enlightenment philosophy dating back to the 1500s summarized as "humanity's

[4] Earth Day Founder, Senator Gaylord Nelson: retrieved from http://www.wisc.edu/wisconsinpress/books/2095.htm.
[5] Defined by Diamond (2007) as a situation in which a country's geographical area cannot service the consumption levels and wastes of its population.

triumph over nature". This anthropocentric or human-centered discourse avows that people are: fundamentally different from all other creatures on earth; permitted to view nature as a collection of natural resources to be subdued and exploited; and masters of their own destiny that can, via human knowledge and technology, overcome all natural and environmental challenges (Jacob 1994, Williams and Millington 2004, Hopwood 2005). In the North American context economic development is predicated on the assumption that we can take what we want, when we want, for ever. As O'Riordan (1996) notes, there is a belief that economic growth is a valid measure of 'progress' however this growth comes at the expense of the environment.

Ecological schools of thought are often positioned as 'shallow' or 'deep' however, closer inspection reveals a spectrum of environmental thought with proponents seeking to alter either the supply or demand side of the economic equation – resource or consumption respectively – while seeking harmony amongst the representative three overlapping circles of sustainability (Figure 16). Clift (2007) stresses that human activities are limited by three sets of long-term constraints: eco-centric (natural resources and ecological capacity); techno-centric (techno-economic systems); and socio-centric concerns (human capital and social expectations). "Sustainable development involves moving towards complying with all three sets of constraints, not trading off one set of objectives against another" (Clift 2007, 263). O'Riodan's 1989 visual mapping of the various schools of thought on sustainable development is shown in Figure 24.

Figure 24 O'Riordan: Mapping views on sustainable development



Source: O'Riordan 1989, in Hopwood 2005, 41.

Deep ecology, first introduced by Norwegian philosopher Arne Naess in the 1970s, views the ecosystem as a 'living whole' asserting that while sustainable development is for the satisfaction of human needs, it also protects the planet for its own sake (Naess 1990). Developed in conjunction with George Sessions in 1984, Table 7 presents Naess' deep ecology platform.

Table 7 Naess: Deep ecology platform

1. Florishing of human and nonhuman beings has value in itself. The value of nonhuman beings is independent of their usefulness to human beings.
2. Richness of kinds of living beings has value in itself.
3. Human beings have no right to reduce this richness except to satify vital human needs.
4. The fourishing of human life is compatible with a sustantial decrease of the human population. The fourishing of nonhuman life requires such a decrease.
5. Current human interference with the nonhuman world is excessive, and the situation is rapidly worsening.
6. Policies must be changed in view of points 1-5. These policies affect basic economic, technological, and ideological structures. The resulting state of human affairs will be greatly different from the present.
7. The appreciation of a high quality of life will supersede that of a high standard of life.
8. Those who accept the foregoing points have an obligation to try to contribute directly to the implementation of necessary changes.

Source: Naess and George Sessions (1984), in Naess 1990, 565.

Deep Ecologists respect nature and view Earth's resources as finite. Consequently, people must adapt their lifestyles to consume less rather than assuming that Earth can meet their ever increasing needs: "no habitable future is possible unless the demand-side of the equation radically alters by rethinking our attitude towards nature as well as our view of economic progress and 'development'" (Williams and Millington 2004, 102). In contrast, shallow ecologists (as noted at the beginning of this section and which includes Brundtland, WCED and IUCN) take a more techno-centric view holding that it is possible to expand the stock of resources by "developing renewable resources, creating substitutes for non-renewable resources, making more effective use of existing resources, and/or by searching for technological solutions to problems such as resource depletion and pollution" (Williams and Millington 2004, 100).

Many authors assert that the theory and practice of sustainable economic development has made rapid progress since Naess' writings and now provide the "opportunity to solve a range of environmental and economic problems and to promote new economic activities that can generate jobs" (Roberts 2002, 126). Naess however, (writing in 1990) held a negative view

on Western progress towards deep ecology and asserted that there were "few or no communities, societies, or cultures that show clear long-range sustainability, which [he defined] as long-range ecological sustainability combined with a satisfactory life quality" (Naess 1990, 575) however, he noted 'satisfactory' is undefined. Naess predicted that "in practice, we shall have to fight obviously unsustainable kinds of development for a long time while implementing changes that lead toward sustainable development" (Naess 1990, 575). He noted that "the great future effort to reduce per capita degradation of conditions of life on Earth will demand discipline and changes of life habits" (Naess 1990, 574) and identified the significant difference in valuing non-human life as the main area of tension between the shallow and deep ecological approaches.

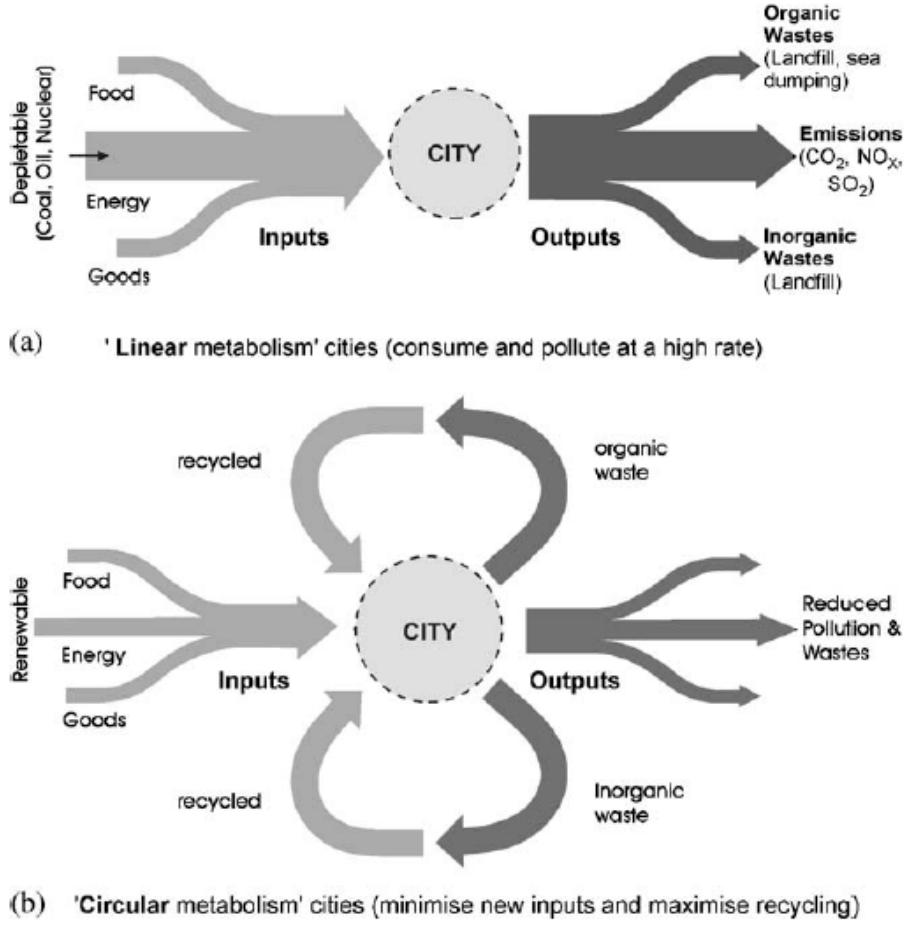
O'Riordan's mapping is a useful model or tool that aids in differentiating the various discourses on sustainable development. While he clarifies the relative position of the many discourses, plotting these as fixed points on an 'x-y axis' can also be problematic. Models, by definition, reduce complex social reality to simplified diagrams and thereby ignore troublesome inconsistencies. A prime example of this is the classic 1925 mapping of concentric zone theory by Park and Burgess of the University of Chicago, School of Sociology. Another example is cognative or "mental mapping" popularized by Lynch (1959) in *The Image of the City*. In addition, O'Riordan's mapping is dated and thereby does not include the more avant-garde view of sustainable development found today in, for example, Hopkins' *Transition Movement*, that originated in the UK and that is useful in helping communities transition to more sustainable communities. Hopkins (2008) in *The Tranisition Handbook: from oil dependence to local resilience* guides us forward to a more progressive energy paradigm. If added to O'Riordan's mapping it would be located in the upper right quadrant.

3.3.1 Gaia Theory - Linear and Circular Metabolism of Cities

Doughty and Hammond (2004) comment that cultural ecologist Girardet considers whether or not cities are sustainable in *The Gaia Atlas of Cities (1992)* without providing an answer and argues for changes in planning and organization by identifying the many 'dis-benefits'. Girardet (1992) and Rogers (1997) discuss the 'metabolism' of cities in working towards sustainability, noting that both inputs and outputs of modern urban living are unsustainable. Fedrigo (1999), Roberts (2002) and Gibbs (2002) concur as they discuss the shift from a linear to cyclic economy under a community-based economic development model that makes existing business activity more environmentally sustainable. This work builds on the *Gaia Hypothesis* (Lovelock and Margulis 1974), which developed into the *Gaia Theory* (Lovelock 1988), which asserts that the Earth and the life it sustains is a system capable of regulating the temperature and composition of the Earth's surface keeping it comfortable for living organisms. Naess (1990) notes the *Gaia Hypothesis* has shown its value both as a working hypothesis and as a way for Western cultures to experience the Earth as something living, as alive in a broad sense.

Doughty and Hammond build on Girardet and Rogers research illustrating their holistic vision or linear versus circular metabolism of cities, concurring with deep ecologists that Earth's energy resources are finite and drawing from the study of natural ecosystems, in Figure 25.

Figure 25 Linear and circular metabolism of cities



Source: Doughty and Hammond 2004, 1230 (adapted from Girardet 1992 and Rogers 1997).

Kenworthy calls cities "parasitic organisms" since ecological footprints of prosperous cities extend far beyond their boundaries and quotes Newman and Jennings (2004) asserting "cities must become more sustainable ecosystems in their own right" in order to avoid ecological collapse (Kenworthy 2006, 75). As Diamond (2005) concludes ecological collapse is the inevitable demise of communities that live beyond their environmental means. Cities must therefore reduce resource use, decrease waste outputs, and increase renewable energies and environmental technologies. Kenworthy's aim (2006, 76) is to maximize a city's ability to meet their needs from the natural capital of their own bio-regions in a renewable way, moving to

"closed loop infrastructure systems" creating circular metabolisms (see Figure 25) that produce, recycle and re-use their own wastes, so that the absorptive capacities of natural systems are not overwhelmed with the waste loads from urban areas" (Kenworthy 2006; Girardet 1992 and Rogers 1997).

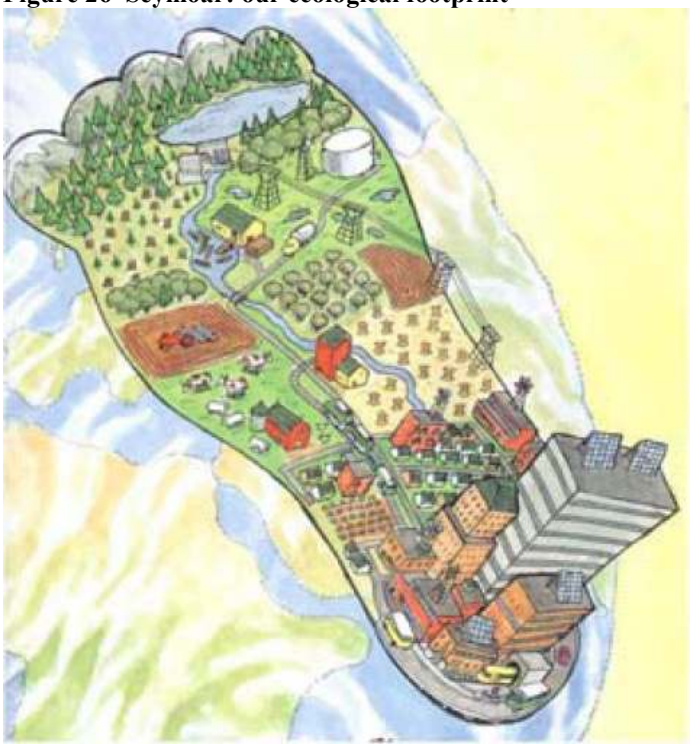
While 'circular' metabolism improves on 'linear' metabolism, both concepts visualize cities as a series of throughputs. To be truly holistic or 'closed loop' entities, communities must rethink 'inputs' (depicted in Figure 25 as food, energy and goods). In a new paradigm, each of these must be generated within the community thereby benefiting the community economically, environmentally and socially. Cities need not be 'parasitic organisms': food can be grown locally on green roofs, energy can be renewable powered by solar and wind, and goods can be produced locally.

3.3.2 Carrying Capacity and Sustainability Gaps

Carrying capacity is a term (Mikolajuk and Yeh 2000) borrowed from biology - as defined in wildlife management, "the maximum number of animals of a given species and quality that can, in a given ecosystem, survive the least favorable conditions within a stated time period" (Edwards and Fowle 1955, Dasmann 1964 cited in Mikolajuk and Yeh 2000, 14). In a sustainability context, Doughty and Hammond (2004) explain "modern cities require vast amounts of resources, both for their urban inhabitants and for the economic activities concentrated there. They remain dependent on an ever-expanding hinterland to supply these resources…. Consequently, they cannot be viewed as sustainable in the limited sense of being self-sufficient, reliant on their own carrying capacity as a resource base" (Doughty and Hammond 2004, 1225).

The concept of ecological footprints (Figure 26) was developed by Rees and Wackernagel in the 1980s and provides an assessment tool of sustainable development by reducing all impacts to a common basis in terms of 'hectares per capital', providing a quantitative basis for evaluating the environmental impact of a population and raising awareness of the consequences of human activity. Doughty and Hammond (2004, 117) note that the term has been adopted in planning circles to focus on the city and, using land as a unit of comparison, to effectively measure the sustainability of cities by considering the flows of materials into and out of the city. Similarly, Girardet terms this the metabolism of cities (see Figure 25).

Figure 26 Seymoar: our ecological footprint



Source: Seymoar 2004, 15.

A 'sustainability gap' occurs when consumption patterns (based on four consumption categories: energy use, the built environment - the land covered by a settlement and its

connection infrastructure, food, and forestry products) result in ecological footprints which are far greater than the amount of geographically available land able to support them. Importantly this is not a direct correlation with urban population size or geographic land area rather it depends on the level of overconsumption and building density. Further, the consequences of human consumption can be graphically viewed when ecological footprints are compared to carrying capacities of communities (Doughty and Hammond 2004, 1228).

McManus and Haughton (2006) conclude that the ecological footprint concept encouraged urban planners and environmental managers to look beyond the traditional scale of planning and environmental management to consider the regional and international environmental impacts of a city's activities. Doughty and Hammond (2004) concur that ecological footprint analysis is important as an integral part of 'systems thinking' but caution against turning a technical tool into a political tool. What is important to understand here, however, is as Clift states, in energy or thermodynamic terms, "the earth is …, a closed system. Thus, energy flux is received from the sun, but the 'capital' resources available to us on a global scale are finite, as is the capacity of the biosphere to absorb or adapt to the emissions from human activities" (Clift 2007, 263).

3.3.3 Section Summary

In conclusion, Jacob (1994) warns that categorizing theoretical thoughts on sustainable development as either 'deep' or 'shallow' is problematic, failing to recognize the substantive differences within the shallow perspectives and creating the mistaken impression that deep ecology is the only environmental perspective that promotes radical change. Mikolajuk and Yeh

(2000) reason that no general agreement on the concept of sustainable development exists due to a multitude of factors including: income, education, social structure, and ideology. Cameron (1991) suggests that these factors are prioritized differently by proponents of each link (social, economic and environment) depending upon what each values the most. Douglass (1985) extends this reasoning further, noting that the three scientific disciplines each approach and analyze sustainability differently: economically, the primary concern is to meet society's demand for material goods in a way that yields an economic return on a continuing basis; ecologically, the stewardship perspective is concerned with maintaining the health of natural ecosystems; and sociologically, the community perspective is concerned with the conservation of social phenomena such as community structures, lifestyles and quality of life.

Rees and Wackernagel's ecological footprint concept can be used to assist communities in understanding that radical transformation is necessary in how we power our communities. O'Riordan's mapping (while some aspects are problematic) can aid in understanding various interpretations of sustainable development. Finally the concept of circular metabolism provides a mental model that can allow us to visualize a city that is not a "parasitic organism".

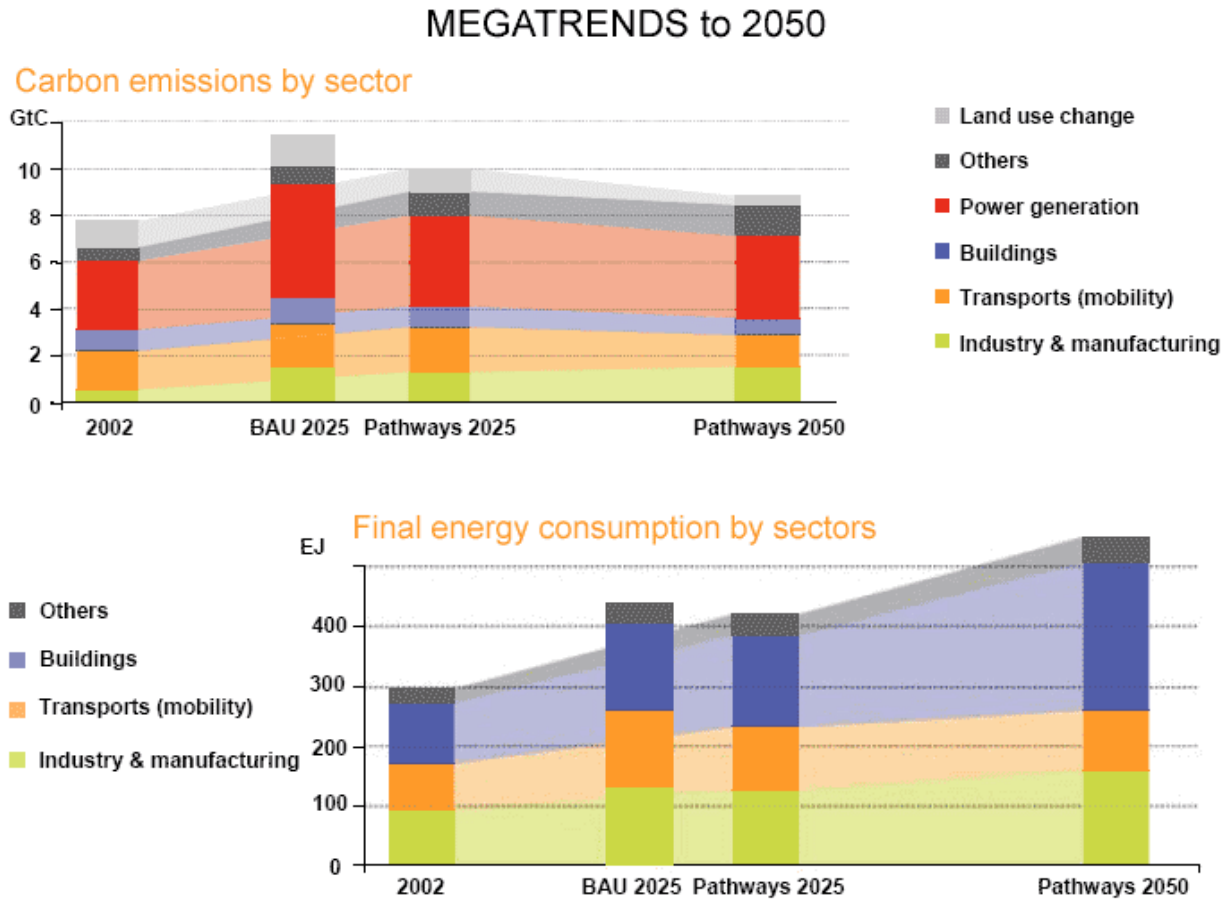
3.4 Link 2: Planning and Sustainable Communities

The connection between planning and sustainable communities is evidenced in the way that planning contributes to climate change and its subsequent effect on communities. The complexity of sustainability in urban land use patterns has been widely debated in planning literature and numerous researchers assert that current inefficient land use patterns are of major concern for sustainable development. These include low-density, single-use, and leap-frogging

urban growth on city outskirts, rapid open space development at the urban edge without considering the redevelopment of declining inner cities, and patches of single land use (Leccese 2000, Silberstein and Maser 2000, Ward 2003, Williams 2000, in Ligmann-Zielinska 2006). According to Barton (1990) land use arrangements have a direct bearing on up to 70% of the consumed energy in Canada. While transportation accounts for much of this percentage, energy consumed by buildings for residential, commercial and industrial use in Canada is estimated at 32% by Statistics Canada and globally at 40% of the world's energy demand (33% in commercial buildings and 67% in residential) by WBCSD. Further, at the current rate, worldwide energy consumption for buildings is expected to increase 45% between 2002 and 2025 with global carbon emissions predicted to rise 92% between 2002 and 2050[6] as illustrated in Figure 27. The WBCSD notes that new technologies and practices have been developed to improve energy efficiency in buildings, but relatively few are being implemented.

[6] Available from the WBCSD website using the following link: http://www.wbcsd.org/templates/TemplateWBCSD5/layout.asp?type=p&MenuId=MTA5NQ&doOpen=1&ClickMenu=LeftMenu

Figure 27 WBCSD: Carbon emissions and final energy consumption by sector – megatrends to 2050



Source: WBCSD website.

As the Planning Institute of Australia (PIA) asserts, "… we now know that the impacts of our present fossil fuel-based, centralized energy supply systems are unsustainable. We need to rethink the way we supply and use energy: and, since most of our energy is either in or for cities, they must be a key focus of our attention" (PIA 2006, 133). Energy matters: land-use and energy planning are central to cities and planners and municipalities need to consider energy choices within their sustainable community initiatives. PIA (2006, 133) recently published four areas of concern:

1. "As cities grow and energy needs escalate, meeting the supply of inner city and industrial areas, and providing the infrastructure to deliver

energy to spreading developments becomes increasingly difficult. Inefficient energy usage results in higher energy needs and increased air emissions.
2. To meet future consumption needs and manage air emissions, the sustainable city must diversify its sources of energy generation and, where possible and appropriate, incorporate renewable energy sources.
3. A sustainable city would successfully uncouple economic growth from increased energy consumption.
4. Lower energy consumption rates, greater efficiency and increased use of renewable energy sources have potential benefits for cities in terms of reduced infrastructure costs and air emissions, and more secure long term access to energy sources."

In fact, concern is mounting in countries around the world including the UK, China and USA. Kelly and Marvin (1995) commenting on the UK, observe a lack of policy interest in the relationship between provision and management of utility services and town planning systems. This is problematic as utility service is fundamental to the planning process and if utilities are not part of the process then, rather than supporting local or regional governments, they may inadvertently increase levels of social and spatial polarization and environmental degradation.

Sadownik (1998) in a Chinese context, considers the following CEM key strategies: maintaining and encouraging land use that will reduce the demand for travel and stimulate the penetration of environmentally benign energy supply technologies such as district energy; encouraging site and building design that minimizes heat and cooling energy losses to the environment; encouraging local energy supply and delivery systems such as renewable energy and cleaner fuels (Sadownik 1998, iii).

Soleri, working in the USA demonstrates that utility service and renewable energy initiatives can be embedded into the town planning process in his progressive community "Arocsanti" (Arizona). Soleri has incorporated 'soft technologies' such as solar and wind power into Arcosanti's urban infrastructure. As Grierson (2001) notes, "arcology" fuses architecture

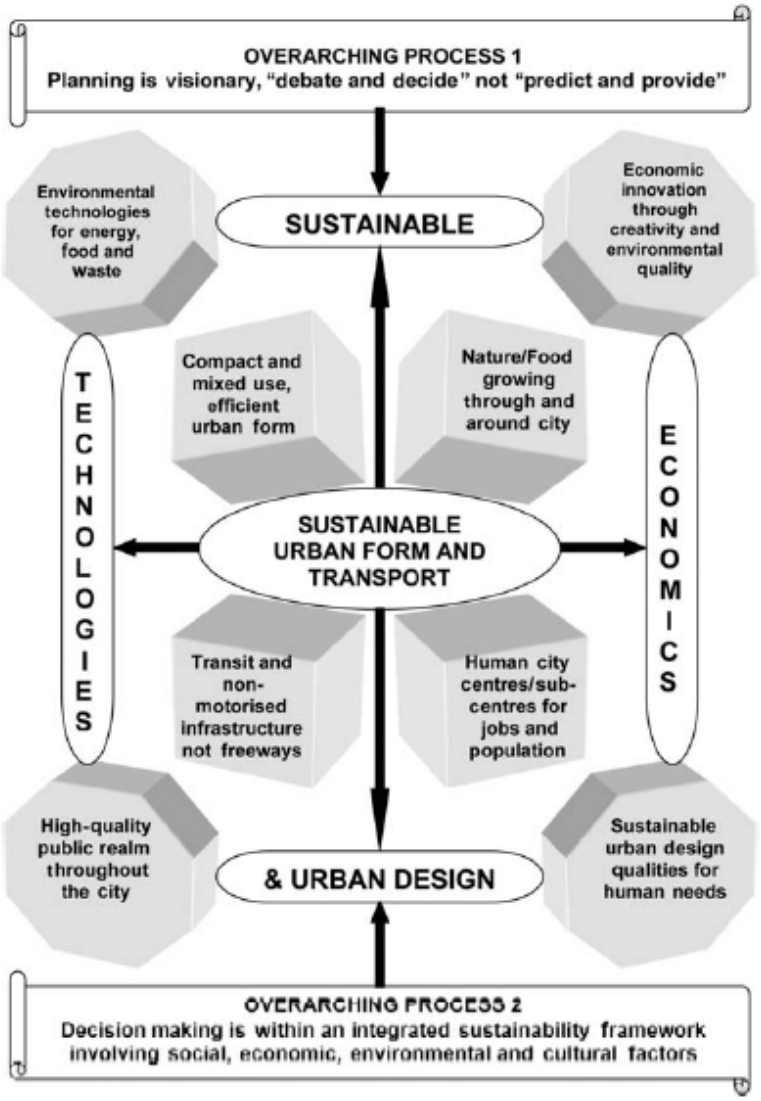
with ecology aiming at eliminating the automobile, promoting walking, using renewable energy and designing a workable alternative to today's unsustainable patterns of urban development.

3.4.1 Planning Initiatives

In response to increasing pressure (Haughton and Counsell 2004) planning's mandate for pursuing sustainable development has essentially become its core objective. One example is the Smart Growth urban planning movement that seeks to conserve land resources (especially greenfield sites) by pursuing urban compaction policies. These typically involve higher residential densities, zoning that permits more mixed land use, encourages transit oriented design, promotes brownfield redevelopment and infill projects. Academic researchers such as Calthorpe and Rogers are also promoting these strategies.

Kenworthy's (2006) planning framework (Figure 28) identifies four necessary elements for more sustainable urban form: environmental technologies (ideally closed loop systems) need to be applied; economic growth needs to emphasize creativity and innovation; public realm needs to be of high quality throughout the city; and sustainable urban design principles need to be applied. Importantly, these elements need to operate within two overarching processes: firstly, visionary planning ('debate and decide' not 'predict and provide') and secondly, decision-making must be conducted within an integrated sustainability framework.

Figure 28 Kenworthy: Conceptual model of eco-cities



Source: Kenworthy 2006, 71.

3.4.2 Planners' Tools are Relevant

CMHC research identifies three levels of energy-related choices (illustrated in Table 8): level one - infrastructure and land use patterns; level two - major production processes, transportation modes and buildings; and level three - energy using equipment. Planners influence many aspects of the top two tiers, especially density, mix of land uses, transportation networks, building and site design.

Table 8 CMHC: Hierarchy of energy-related choices

Level 1: Infrastructure and land use patterns	
▪ Density ▪ Mix of land uses ▪ Energy supply infrastructure ▪ Transportation networks	⇦ Local plans, master plans, property tax structure, lot levies, right-of-way allocation.
Level 2: Major production processes, transportation nodes and buildings	
▪ Choice of industrial process ▪ Choice of transportation mode ▪ Building and site design	⇦ Local codes and standards, user fees, parking policies and pricing, local demand management programs, industrial and economic development policies.
Level 3: Energy using equipment	
▪ Transit vehicles ▪ HVAC systems ▪ Appliances ▪ Motors	⇦ Local procurement practices, influence of local codes and regulations, education programs.

Source: CHMC 2003, 2.

In fact, Williams et al. (2006) note 'building blocks for sustainable urban form' include a variety of planners' tools: density control, building and infrastructure design, and zoning and regulatory bylaws - each discussed in this section. According to Ligmann-Zielinska (2006) these can effectively manage growth through intensification, extensification, or decentralization strategies thereby achieving sustainability objectives.

3.4.2.1 Density

While density is an elusive element to quantify it remains an important component of sustainability. The effects of urban sprawl are well documented and a compelling case for compact cities has been made. Doughty and Hammond (2004) assert "clusters of buildings and an integrated human-scale transport infrastructure can enhance energy conservation and reduce environmental impact" (Doughty and Hammond 2004, 1223). Interestingly Owens (2004)

extends this argument to New York City in his article, *Green Manhattan* – however, a caveat is in order as he acknowledges it may not be quite what environmental planners envision!

Figure 29 illustrates Kenworthy's research findings and identifies Canada as having one of the lowest urban densities in the world. Comparing Kenworthy's global city densities data (Figure 29) against Jean-Baptiste and Ducroux's per capita energy consumption by country data (Figure 8) and Scientific American's average per capita CO_2 emissions data (Figure 9) reveals an interesting inverse relationship. Canada and the USA have the lowest urban density rankings and the highest energy consumption and emissions. This suggests that density, consumption and emissions are inversely related. (Similarly, Kuznet's Curve presented in Appendix B, correlates economic development and consumption.)

Figure 29 Kenworthy: Urban density in a global sample of cities, 1995

	CHN	LIA	LAM	AFR	MEA	EEU	WEU	HIA	ANZ	USA	CAN
Urban density (persons/ha)	146	204	75	60	119	53	55	150	15	15	26
Proportion of jobs in CBD (%)	51	17	29	15	13	20	19	19	15	9	16

Legend of cities: **CHN** Chinese; **LIA** Low-income Asian, **LAM** Latin American, **AFR** African, **MEA** Middle Eastern, **EEU** Eastern European, **WEU** Western European, **HIA** High-income Asian, **ANZ** Australia / New Zealand, **USA** United States, **CAN** Canada.

Source: Kenworthy and Laube 2001, in Kenworthy 2006, 71.

The CHMC study of typical housing form densities and sizes of typical cities (Tables 9-10) and Jaccard's definition of development classes (Table 11) are useful in considering this relationship and can guide planners in setting density targets and aid in understanding the impact that built form may have on energy consumption, however, more research is needed on this topic.

Table 9 D'Armour: Typical densities of different house forms

Density	Housing Type	Storeys	Units / Net Ha	Persons / Net Ha
Low	Single Family Detached	1-2	12-17	43-48
	2 Family	1-2	19-29	48-84
Medium	Row Houses	2-3	24-48	72-144
	Garden / Walkup Apt.	3-4	48-96	120-192
High	Multi-family (low)	5-10	96-192	192-360
	Multi-family (medium)	10-16	192-240	360-480
	Multi-family (high)	16+	240-960	480-1,680

Source: D'Amour 1993, 12, in CMHC publication 2003, 2.

Table 10 CHMC: Population densities for different sizes of Canadian cities

Population Class (No. of urban regions)	Population Density Population per Ha
25,000 - 50,000 (26)	9.0
50,001 - 100,000 (18)	9.8
100,001 - 250,000 (13)	12.8
250,001 - 500,000 (4)	19.5
> 500,000 (9)	19.5
Average for 70 regions	16.5

Source: CMHC 2003, 2.

Table 11 Energy Research Group: Definition of development classes

Development Class	Building Types[2]	Land use Mix	Alternative Transportation Access	Residential Density
Sprawl	100% single detached dwellings	land use mix is minimal (mainly residential)	limited access to transit, pedestrian and cycling facilities	7 dwelling units per hectare
Compact	60% single detached dwellings, 20% single attached dwellings, 20% apartments	land use is moderately mixed, including some residential / commercial building integration	moderate access to transit, pedestrian and cycling facilities	13 dwelling units per hectare[3]
Node	5% single detached dwellings, 25% single attached dwellings, 70% apartments	land use is widely mixed including some residential / commercial building integration	significant access to transit, pedestrian and cycling facilities	27 dwelling units per hectare[4]

Source: Energy Research Group / MK Jaccard and Associates, Sadownik et al, 1999, Appendix A, 2.

Note 2: Building type definitions are from Statistics Canada (1997). These definitions are used to calculate energy use forecasts for the residential sector in Canada's Energy Outlook, the source of data for Jaccard's research.

3.4.2.2 Building and Infrastructure Design

Planners' tools can transform how buildings are conceived, constructed, operated and dismantled. Buildings constructed without using energy from the power grid will require a combination of onsite power generation and ultra-efficient building materials and equipment. "Green" buildings exist in many parts of the world but current cost structure and weak regulatory arrangements prevent widespread adoption by general contractors. The WBCSD plans to use their "Energy Efficiency in Buildings" program to align costs and benefits and to work in close collaboration with architects, builders, suppliers and building owners to promote a more sustainable approach to construction. In Canada, LEED standards are being adopted and other building standards enhanced as exemplified by the Ontario municipality of East Gwillimbury.

On March 20, 2006 East Gwillimbury Council passed a municipal resolution directing developers of residential developments of ten or more units to construct to Energy Star® qualification which is approximately 30% to 40% more energy efficient than those built to minimum Ontario Building Code standards. This increase in energy efficiency translates into reduced energy costs for homeowners and reduced GHG emissions for the municipality. This resolution resulted from the combined efforts of elected representatives (Mayor Young, Councillors Johnston, Morton, Hackson and Hauseman), Ontario's Chief Energy Conservation Officer (Love) and private sector participants (Enerquality Corporation, Minto Homes and Crystal Homes). As additional incentive, CMHC offers a 10% refund on its mortgage loan insurance premium when borrowers buy or build energy efficient homes.

Porcher (2006), in conjunction with Holland Barrs, notes that design strongly influences sustainability primarily since the initial design of infrastructure once built, lasts a long time and influences energy consumption over its duration. Her research on the "Obsolescence Cycle of a

City" calculates life-spans of various city projects as follows: city structure and layout (subdivisions and roads) at 75-200+ years; buildings at 50-100 years; infrastructure at 20-100 years; landscape at 10-100 years; and systems and equipment at 5-20 years. Sadownik and Jaccard (1999) concur noting "the way urban form unfolds will orient energy patterns far into the future. It is therefore critical to shape urban form and infrastructure patterns so that more sustainable energy paths can be followed. CEM should be an important component of a sustainable energy strategy…" (Sadownik and Jaccard 1999, 63).

3.4.2.3 Zoning and Regulatory Bylaws

Zoning bylaws governing traditional areas (such as mixed use, parking, density, placement of buildings on lots, road width and materials) may need updating as well as other regulatory bylaws (including drainage control, subdivision and development control, erosion and sediment control, comprehensive development agreements and phased development). Conversely restrictive zoning, one of the greatest barriers to sustainable community development, should be reviewed. Bylaw reviews can pinpoint problematic regulations that might impede desired sustainable development patterns.

Green roofs, solar panels and wind turbine technologies will all require new regulatory frameworks, zoning and bylaws. One example of this involves the Municipality of Grey Highlands (MGH) which between 2004 and 2005 reviewed six discussion papers considering commercial wind energy facilities as a compatible land use, exploring the most appropriate planning approval framework, and assessing changes needed to their Official Plan, zoning bylaws and site plan approvals to encourage renewable wind energy.

3.4.3 Section Summary

This section explored the link between planning and sustainable communities. Arcosanti, in Arizona, provides a working example. Soleri demonstrates that renewable energy can successfully be integrated into the town planning process. Importantly, this section comes to four conclusions. Planners can influence sustainable development through dialogue, policy and planning tools. Energy consumption is directly related to building design, urban layout, and densities and utility service is fundamental to urban planning. Infrastructure, as a result of its long asset life, has the ability to influence energy consumption long into the future. Finally, planners working with utility companies and municipal governments can influence the infrastructure provision process and ensure that communities build it right the first time, thus casting a legacy that will influence future generations.

3.5 Closing the Sustainability Gap

> *"You never change things by fighting the existing reality. To change something, build a new model that makes the existing model obsolete." Buckminster Fuller*

Dale's (2008) preliminary research concludes that while many communities have conducted reviews, commissioned consultant reports determining what is needed for change, these changes have not yet been implemented. This section considers Walker and Cass' (2007) 'community' as a mode of transition, considers the concepts of facilitation and learning organizations (necessary prerequisites for organizational change) and considers if Canadian transitional frameworks (ICLEI and ISCP) are allowing municipalities to become learning organizations.

Walker and Cass (2007) identify one of five modes of implementing renewable energy systems is 'community' with the other four being public utility, private supplier, household and business (see Figure 30). They suggest solar, wind, hydro, biomass, and heat pump technologies for generating energy and envision that in a community approach energy configurations "could be radically different – smaller-scale, locally appropriate, environmentally and socially benign. Some would be grid connected distributing excess electricity generated and some would be off-grid, supplying and distributing energy locally to a single building, a network of buildings or to a wider community" (Walker and Cass 2007, 461).

Figure 30 Renewable energy in the UK - five modes of implementation

Modes	Underlying discourses	Technologies	Size	Function and service	Ownership and return	Management and operation	Infrastructure and networking
Public utility	Universal provision	Hydroelectric	Macro	Electricity for grid and distanced consumption	Public, return to state	Publicly owned utility	National electricity grid
Private supplier	Neoliberal market logic, consumer choice	Wind, waste to energy, hydro	Macro and meso	Electricity for grid and distanced consumption	Private, differentiated, return to shareholders	Privately owned utility; differentiation in roles	National electricity grid; regulated market
Community	Neocommunitar-ianism, participation, sustainable communities	Solar, wind, hydro, biomass, heat pump	Meso and micro	Electricity or heat for local consumption and/ or grid	Multiple models; partnerships, cooperatives, user-led; some 'collective' return	Multiple models; partnerships, user-led, cooperatives	Off grid and/or feed to national or local network (heat or electricity)
Household	Personal environmental responsibility, self reliance, autonomy	Solar, wind, hydro, biomass, heat pump	Micro	Electricity or heat primarily for local consumption	Household as owner or host; direct or indirect return to household	Multiple models; plug and play, company driven, microgrid	Off-grid and/or feed to national or local network (heat or electricity)
Business	Corporate social responsibility, business efficiency	Solar, wind, hydro, biomass, heat pump, waste to energy	Meso and micro	Electricity or heat primarily for local consumption	Business as owner or host; direct or indirect return to business	Multiple models; plug and play, company driven	Off-grid and/or feed to national or local network (heat or electricity)

Source: Walker and Cass 2007, 462.

Similar models are suggested by the David Suzuki Foundation, the Pembina Institute and NRCan – these are distributed generation (DG) and district energy (DE). The term DG refers to renewable energy technologies installed as small-scale (typically 3 to 10,000 KW) power generation units along the grid, close to where electricity is used (a home or business) that are alternatives or additions to the traditional electric power system. Benefits of DG result from reductions in power losses associated with centrally generated power systems (due to long-haul

transmission and distribution requirements), reduced capital costs and more environmentally friendly renewable energy from wind, solar and other sources.

DE is cited as an alternative heating, cooling and power system to conventional boilers, furnaces and chillers. It maintains the desired temperature using a system of buried pipes (distributing hot or chilled water) to buildings from one or more central heating or cooling plants. Reduced emission levels result from efficiencies, combining heat and power production and better emissions control. Technologically feasible, DE works on a hierarchy of energy types that already exist in urban communities ranging from fossil-fuels (oil, heavy bunker or coal), to renewable fuels (wood, wood waste or peat) to industrial waste heat (from electrical power generation (combined heat and power or CHP), to waste (garbage, municipal solid waste, and methane from landfill sites). While most DE systems are found in Northern Europe, approximately 80 systems operate in Canada with the majority (38 percent) in Ontario. The earliest date back to the 1880s with the majority found on university campuses while others exist in larger institutions and some communities (such as Markham District Energy).

3.5.1 Facilitating the Change

Facilitation has been called “leadership in action” and can be used to overcome challenges associated with achieving change and transitioning to new paradigms. This section of the paper provides academic research as to how facilitation is essential to environmental change and suggests that planners can extend their traditional role as facilitators to include energy concerns.

Traditionally government has been the protector of the “public good”, however, academics such as Hartman, Hofman and Stafford (1999, 255) observe that environmental

problems (such as climate change) are now too complex to be solved solely by government. As they state, "Sustainability warrants alternative forms of leadership and contributions from industry, citizens, non governmental organizations (NGOs) and other environmental stakeholders" (Hartman, Hofman and Stafford 1999, 255). Lafferty and Meadowcroft (1996) agree stating that representatives from different social sectors (governments, private enterprise and NGOs) must cooperate in developing and implementing innovative solutions to sustainable development. Trist also asserts that a collaborative approach is "the only way to address complex societal problems" (Huxham 2000, 339) and he states that not only *should* we be involved, we have a *moral imperative* to do so. Individually these different researchers arrive at the shared conclusion that society benefits when all sectors focus their energies and collectively work together towards a common goal.

As Owen states, "peace is not the absence of conflict" and tensions are to be expected at some point when collaboration between organizations with different inherent logics is sought. Waddell (2002) concludes that the challenge to successful implementation lies in a collaborative working relationship with a facilitator whose role it is to harness the strengths of these various sectors and promote synergies. The goal is to derive the best from each and foster a spirit of working together. Waddell notes that each sector (public, private and non profit) has different core logics (Figure 31) that result in different priorities. Building on Argyris' research, he explains that single-loop learning involves change within the current rules of the game, double-loop or societal learning means redefining the rules of the game, and triple-loop learning involves participants questioning the way they think about the rules and the game but he warns that inter-sectoral collaborations will by definition produce tensions as second and third loop learning occurs.

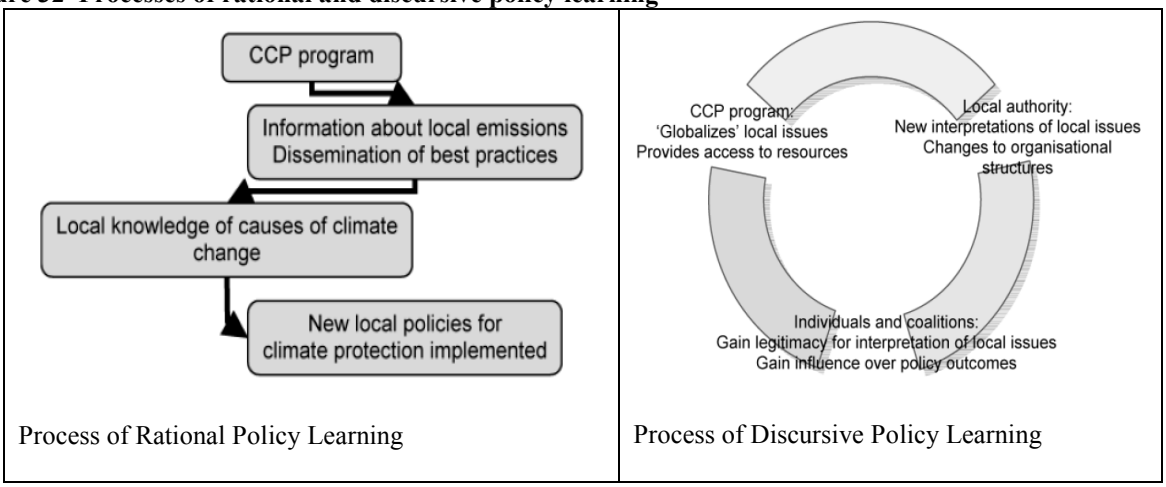
Figure 31 Waddell: Distinctive characteristics of sector core logics

	Government	Business	Civil Society
Primary Interest	Political	Economic	Social
Primary control agents	Voters/rulers	Owners	Communities
Primary power form	Laws, police, fines	Money	Traditions, values
Primary goals	Societal order	Wealth creation	Expression of values
Assessment frame	Legality	Profitability	Justice
Goods produced	Public	Private	Group
Dominant organizational form	Governmental	For-Profit	Non-profit
Relationship basis	Rules	Transactions	Values
Temporal framework	Election cycles	Profit-reporting / business cycles	Sustainability / regeneration cycles

Source: Waddell 2002, 5

Applied to the energy policy context single loop learning is conceived as a "rational process in which policymakers seek alternative approaches to reach a given policy goal" (Argyris and Schon 1978, in Betsill and Bulkeley 2004, 484) (see Figure 32). Given the complex nature of policymaking in local governments, where policy learning has taken place, it has been more akin to a discursive process (see Figure 32). "Policy learning is seen not only as a technical process, in which actors or organizations seek to improve their knowledge of a particular policy problem, but also as involving a 'struggle for discursive hegemony in which actors try to secure support for their definitions of reality'" (Betsill and Bulkeley 2004, 486). This is what Waddell and Argyris term 'double-loop learning' and is where policy challenges create paradigm changes in the underlying norms and goals of policymaking surrounding particular issues and problems.

Figure 32 Processes of rational and discursive policy learning



Process of Rational Policy Learning | Process of Discursive Policy Learning

Source: Betsill and Bulkley 2004, 485-7.

3.5.2 Transitional Frameworks

Applying Waddell and Argyris' research in an organizational context, municipalities, in order to succeed in collaborative endeavors to solve complex environmental problems, must become 'learning organizations' that embrace double and triple loop learning. Two well-regarded frameworks designed to assist municipalities in the transition to more sustainable communities exist: Integrated Community Sustainability Planning (ICSP) partnered with The Natural Step (TNS) framework and the (Canadian) Partners for Climate Protection (PCP) or (USA) Cities for Climate Protection (CCP) framework. Beginning with the latter, the PCP/CCP[7]

[7] PCP is a partnership between the (FCM) Federation of Canadian Municipalities and ICLEI - Local Governments for Sustainability. PCP is the Canadian component of ICLEI's Cities for Climate Protection (CCP) network that comprises more than 800 communities world wide making the same efforts. The PCP program is a network of 157 Canadian municipal governments who have committed to reducing greenhouse gases and acting on climate change. PCP receives financial support from the Green Municipal Fund (GMF) as part of the Capacity Building Program. The five milestone framework is shared by both programs. Further information is available on-line at: http://www.sustainablecommunities.fcm.ca/Partners-for-Climate-Protection/PCP_Milestone.asp

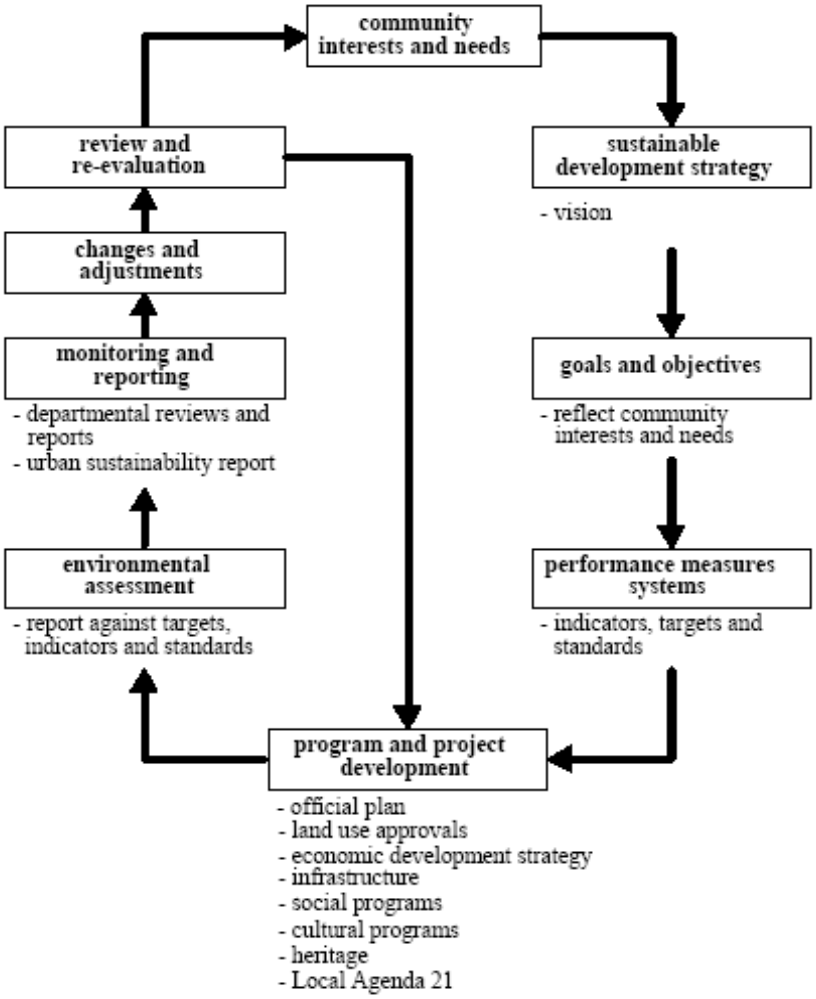
serves as to create new discourses about the nature of (local) climate protection and offers legitimacy and authority to those who embrace its scientific basis and global representation. It provides a software program to help local authorities calculate, forecast, and monitor GHG emissions, provides information on best practices and promotes networking through workshops and publication of case-studies. The PCP/CCP program utilizes a five milestone model: creating a greenhouse gas emissions inventory and forecast; setting an emissions reduction target; developing a local action plan; implementing the local action plan or a set of activities; and monitoring progress and reporting results (PCP website). The emphasis is on increasing capacity to monitor and forecast emissions by developing software tools and on spreading best practice ideas. The assumption is that increased information about the issue and potential solutions will create policy change in a relatively straightforward manner.

Betsill and Bulkley's research highlights the positive aspects and benefits of the PCP program. They note (2004, 478) that PCP members agree that climate change is a problem that can be addressed locally and are committed to a policy approach based on the measurement and monitoring of GHG emissions, suggest that networks such as PCP/CCP are important for the exercise of governance and conclude that the ICLEI program has helped local officials to recognize that climate protection is consistent with energy management and urban sustainability programs which they have already put in place. Their findings reveal that "taking such networks seriously suggests moving away from notions of the unitary nation-state as the primary location of governance and building on the insights offered by the literature on global civil society that networks are in themselves an important site for the exercise of governance" (Betsill and Bulkeley 2004, 479). "By promoting financial savings through energy efficiency, the CCP program has contributed to making additional resources available in each local authority for

investment in further energy management initiatives" (Betsill and Bulkeley 2004, 482). Further they state that membership allows for gathering and sharing technical information on the reduction of GHGs, financial resources, political kudos, endorsements, promoting interests and values with others, as well as making and developing personal connections.

In contrast, Devuyst and Hens' research (consisting of a six case comparison study of sustainable development at the local level in Canada and Flanders) reveals there is little evidence to show this happens. They state, "Canadian municipalities generally did not possess the capacity to do an effective job of integrating or harmonizing assessment and planning. Moreover, there is little prospect that impact assessment and municipal planning procedures will be blended or harmonised in the future" (Devuyst and Hens 2000, 90). Perks et al. (1996) also saw shortcomings in municipal corporate cultures, concluding that hierarchical (centralizing) management and controls characterized the municipal corporate environment and functions are sectorally-divided – in short, "municipal organizations were not yet learning organizations" (Perks et al., 1996 in Devuyst and Hens 2000, 90). Encouragingly they note "the road towards sustainable development is inevitably a search for new ways of thinking and acting. It is a process of change that is focused on better integrating environmental, economic and social considerations into decision-making [that] requires an articulated commitment to continuous learning, improvement and innovation" (Devuyst and Hens 2000, 101). Devuyst and Hens however did select the City of Ottawa, illustrated in Figure 33, as an example of 'good practice' as it incorporates feedback and interactive learning.

Figure 33 City of Ottawa: Municipal environmental evaluation process



Source: Devuyst and Hens 2000, 92.

Hawke-Baxter and Purcell (2007, 35) describe Integrated Community Sustainability Plans (ICSP) as a high level community planning document and process that challenges cities to envision a long-term vision and then 'backcast' from that vision to establish short and medium term goals to guide communities to that future state. ICSPs are strategic business plans that track and monitor progress and that are reviewed on an annual basis. This overarching big picture, holistic framework provides "guidance for the development or alignment of all municipal plans, policies and decisions (i.e. municipal development plan, transportation plan, energy plan,

purchasing policy, capital planning, etc.)" (Hawke-Baxter and Purcell 2007, 35). Developed by Ling, Dale and Hanna at Royal Roads University (2007) the ISCP model includes six stages as illustrated in Figure 34: awareness and scoping; visioning; exploring possibilities; developing strategies; implementation; and monitoring and feedback. ICSPs have seven common elements - they: adopt a long-term timeframe, take a systems approach, integrate the four elements of sustainability, are comprehensive – aligning existing and new plans (ie water, land use, transportation, air), are multi-sectoral (not just governments), involve multi-stakeholders (not just planners), and employ a participatory engagement process.

Figure 34 ICSP: Planning cycle

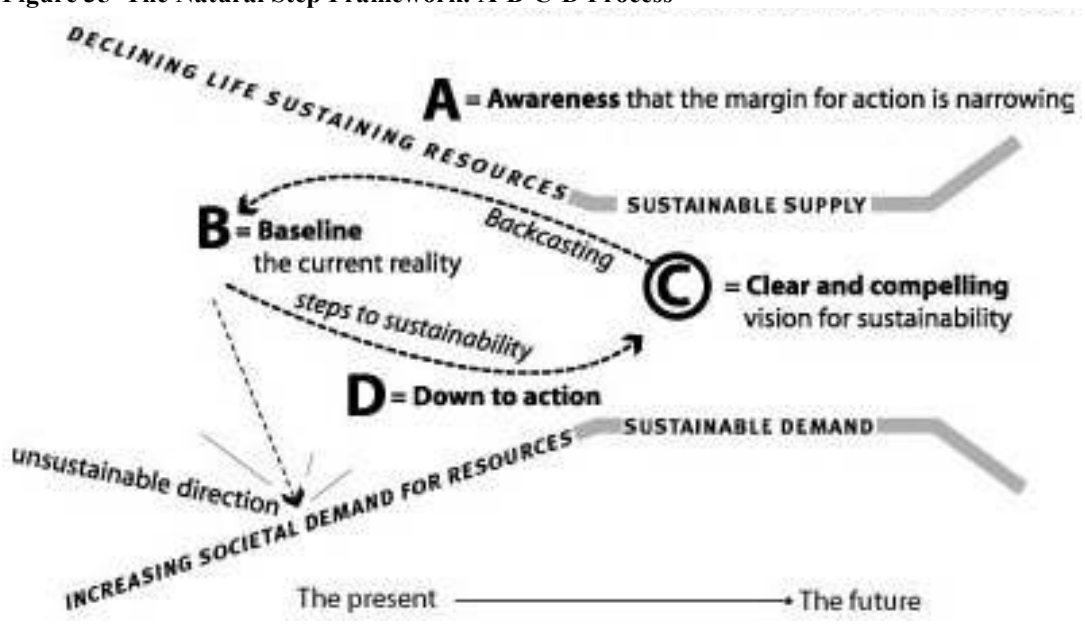
Source: Seymoar 2008.

ISCPs work in conjunction with The Natural Step (TNS) methodology developed by Swedish cancer specialist Karl-Henrick Robert that has four system conditions[8]: firstly, that finite materials (including fossil fuels) should not be extracted at a faster rate than they can be

[8] Further information is available at http://www.naturalstep.org.

redeposited in the Earth's crust; secondly, that artificial materials (including plastics) should not be produced at a faster rate than they can be broken down by natural processes; thirdly, that the biodiversity of ecosystems should be maintained, whilst renewable resources should only be consumed at a slower rate than they can be naturally replenished; and fourthly that basic human needs must be met in an equitable and efficient manner. The Natural Step four element "A-B-C-D" implementation methodology takes an analytical approach and is illustrated in Figure 35.

Figure 35 The Natural Step Framework: A-B-C-D Process



Source: The Natural Step website.

3.5.3 Section Summary

Kelly and Marvin (1995) conclude that "planners need to engage in a fundamental reassessment of the relationship between land use and electricity network planning" (Kelly and Marvin 1995, 220). They warn that if planners do not engage in this debate demand-side management (DSM) programs offered by utilities could have important consequences for land

use planning. This is a result of the neo-liberal landscape and movement to privatization, which may allow utilities to adopt their own strategies thereby allowing them to influence the future of cities, without regard to planners' objectives and with limited links back into the planning process. Kelly and Marvin (1995, 221) call for more research to examine the interface between the management (of the perceived 'neutral', 'boring', 'technical' systems) of energy and its role in structuring cities and regions. On a positive note, they see the potential for new opportunities for utilities and planners to develop ways of mutually shaping the development of cities and localities, observing that new modes of network and land use planning will require innovation in both the utility and planning sectors. Kelly and Marvin (1995) conclude that without such thinking, planners are likely to be left behind as utilities develop their own private versions of planned futures.

4: The SCEP Opportunity in Ontario

Several notable developments have occurred in Ontario that have driven the emergence of Sustainable Community Energy Planning (SCEP) and have made it an opportunity worthy of consideration for municipalities and energy providers in Ontario (including City of Pickering and Enbridge). In addition to environmental and health reasons already discussed, this section considers how the SCEP opportunity arose in Ontario (why the timing is right, the OPA review of the province's energy supply and their predicted "energy gap") and the legitimacy granted to municipalities to become involved in community energy provision by way of the Ontario government's policy shift. These developments are revealed in contents analysis of Ontario energy and planning policies, documents and regulations.

4.1 Energy planning: OPA – Ontario's impending energy gap

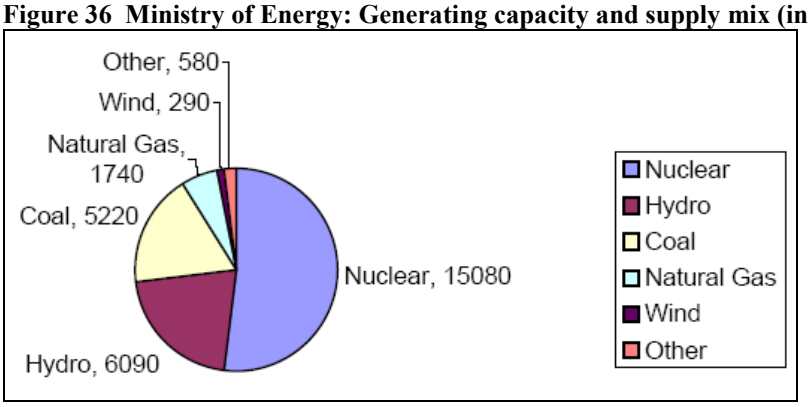
> "Energy is inseparably linked with cities and their people. Energy use based on future energy scenarios, deeply affects the cities of the future, particularly in terms of addressing global environmental issues. Without addressing these connections, efforts at urban management and planning are destined to end in failure. Conversely, the structure of future cities, and the dynamics of people's lifestyles, has serious implications on the energy systems."
>
> Source: Sustainable Urban Systems Design Competition Tokyo, 2003.

The population of Ontario is projected to increase by 4.625 million people to a population of 14.4 million by 2031 (base year 2001). The Greater Golden Horseshoe (GGH), accounting for 80% of Ontario's population, is projected to increase by 3.7 million people to a population of 11.5 million by 2031[9]. Even if conservation and efficiency measures are factored in to the current increasing rate of energy consumption, Ontario's demand for energy will outpace supply. Most of our "energy habits" were shaped by policies of former governments that designed our economy, planned our landscape and built urban environments on a premise of cheap energy. This promoted a culture of overuse with little regard for the implications of this over-consumption. Two problems associated with this are noted by Khan (et al): firstly, "energy is the driving force in the life of contemporary society, but existing technologies and energy usage patterns create negative environmental impacts" (Khan 2007a, 403); and secondly, "our conventional energy sources exist in a limited quantity and some of them are at the depleting stage" (Khan 2007a, 404). The current electricity generating capacity in Ontario (on July 15,

[9] The Ontario publication *Places to Grow* projects an increase of 3.7 million to the GGH (from the 2001 population statistics) to 11.5 million by 2031 accounting for 80% of Ontario's growth. This equates to a projected population growth for Ontario of 4.625 million (*Places to Grow* 2006, 13).

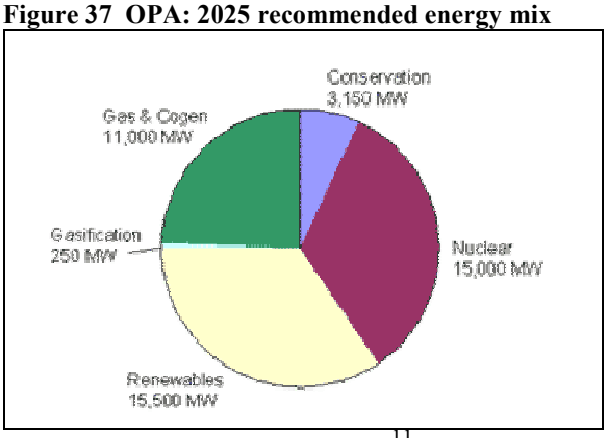
2008) was 29,460 MW[10] and the supply composition is illustrated in Figure 36. The 2025 OPA recommended energy mix is illustrated in Figure 37.

Figure 36 Ministry of Energy: Generating capacity and supply mix (in MW), July 15, 2008



Source: Ministry of Energy website. See footnote 10.

Figure 37 OPA: 2025 recommended energy mix



Source: Ministry of Energy website.[11]

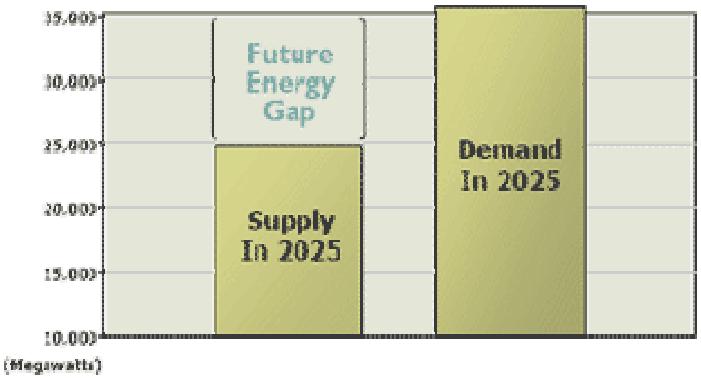
While the supply-demand challenge is quantified and qualified in various ways both the Ministry of Energy and Ontario Power Authority predict an energy gap by 2025 given current trends and projections. By 2014 the Ministry of Energy estimates that demand for energy will

[10] Figures sourced from Ministry of Energy website. Generating capacity on July 15, 2008 was 29,460 MW and demand was quoted at 18,981 MW. Percentages are estimated 2007 electricity generation mix as per IESO. See http://www.energy.gov.on.ca/index.cfm?fuseaction=about.plan0809

[11] Retrieved on November 27, 2007 from http://www.energy.gov.on.ca/index.cfm?fuseaction=english.news&back=yes&news_id=134&backgrounder_id=105

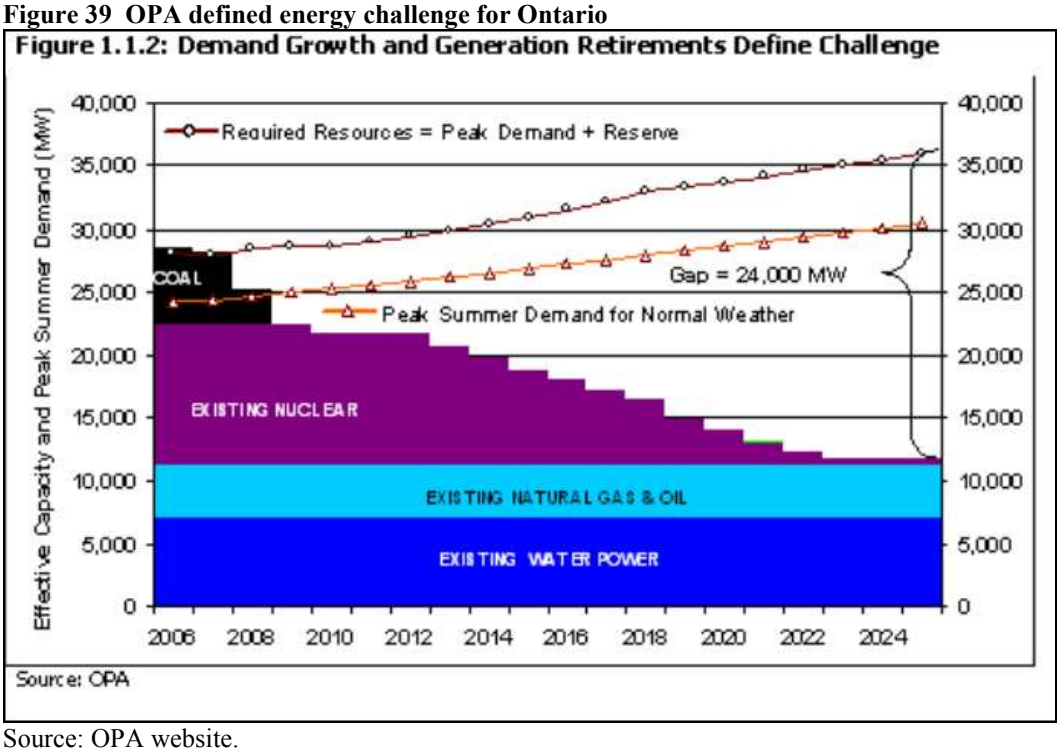
begin to exceed available supply and that by 2025 the energy supply gap will be about 10,000 MW as illustrated in Figure 38. The OPA (which operates under statute passed by the Ministry of Energy) predicts a gap of 24,000 MW when generation retirement objectives are factored in as illustrated in Figure 39.

Figure 38 Ministry of Energy: Ontario's predicted energy gap



Source: Ministry of Energy website.

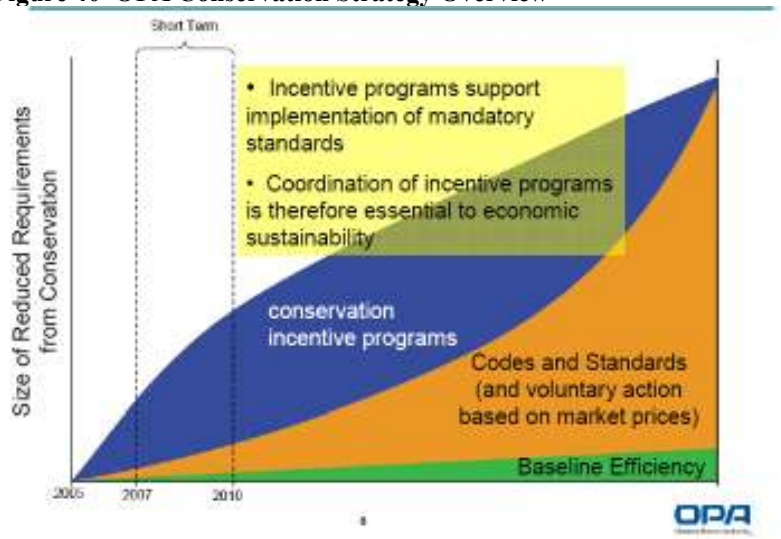
Figure 39 OPA defined energy challenge for Ontario



Source: OPA website.

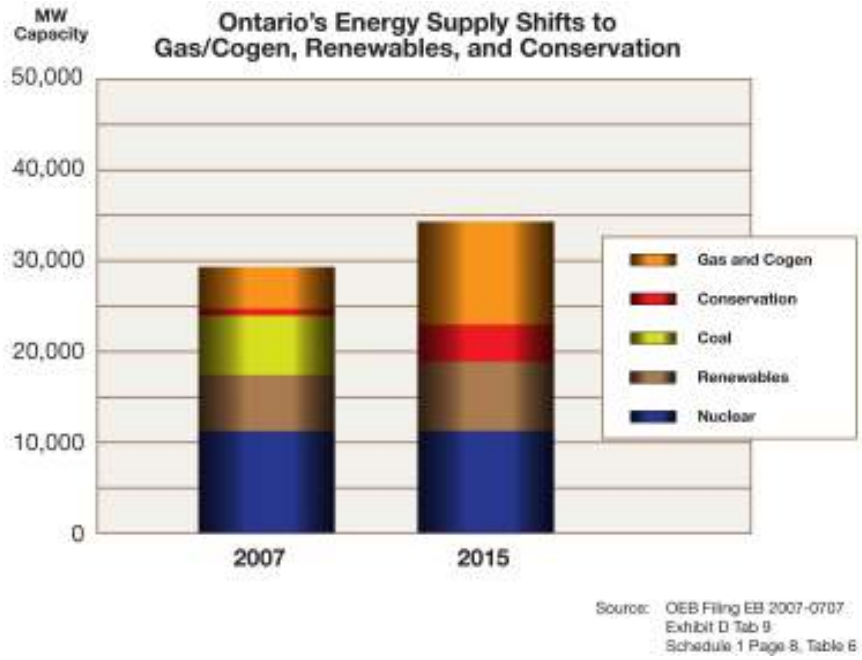
In order to ensure sufficient supply the OPA has drafted the first recommendations of the Province's IPSP through to 2025. In his speech to the CanSIA Solar Conference on November 20, 2007, The Hon. Gerry Phillips cited five priority areas for the Ministry: firstly, conservation (committed to usage reduction of 6,000 MW representing 25% of current energy needs by 2025); secondly, renewables (committed to doubling output by 2025); thirdly, refurbishment and construction of new nuclear facilities (limit output to 14,000 MW); fourthly, defining the role of natural gas in Ontario's future (natural gas should only be used to meet peak demand in high-efficiency applications and to meet local reliability need when no alternative is available); and lastly, elimination of coal plants by 2014. SCEP is relevant to these five priority areas in two important ways: firstly it promotes conservation, efficiency and the use of renewable energy (the first two priority areas) and secondly it aids the elimination, use of and dependency on nuclear, natural gas and coal (the latter three). (See Appendix C: Ontario Political Support for SCEP for a more detailed examination of these priority areas). Figures 40 and 41 illustrate the OPA strategy for creating a "culture of conservation" and Ontario's shifting power supply mix.

Figure 40 OPA Conservation Strategy Overview



Source: OPA Shervill Presentation 2008.

Figure 41 OPA Ontario's shifting power supply mix



Source: Monaco presentation 2007.

4.1.1 Modifying Behaviour

As Ascher (2006) states many strategies can be used to change thinking and modify behaviour with the goal of achieving longer term objectives (Ascher 2006, 21). "The shift from the strictly economic and ordinary policy levels to the constitutive, institutional, and psychological levels is a very important expansion of the relevant framework" and necessitates a combination of "psychology, economics, institutional design, legal studies, political science and other social sciences" (Ascher 2006, 21). However, in regards to sustainable development, he comments that while strategies are understood the will to pursue them is often lacking. Ascher also identifies five obstacles to behavioural change (impatience, selfishness, uncertainty, limited analytical capacity and vulnerability) but remains optimistic in his research, stating "norms of charitability, hard work, frugality, collegiality, care and education of children, etc., often make

very strong contributions to better futures, and operate even when the future is very cloudy." (Ascher 2006, 18). Behavioural change is possible in Ontario as demonstrated by the recent changes towards acceptance of wearing seat belts and the successful anti-smoking campaign.

4.2 Policy Shift: Increasing Municipality Roles and Responsibilities

The IPSP priorities will have far-reaching implications for both municipalities and for energy utilities. Constitutionally energy planning falls within provincial jurisdiction[12] and energy provision in Ontario is overseen by a multitude of provincial organizations (with overlapping mandates) such as the OPA, Ontario Power Generation (OPG), the Ontario Energy Board (OEB), and the Ontario Ministry of Energy (MOE) amongst other provincial boards, agencies and commissions.

Municipalities are creatures of the Province, incorporated under the *Municipal Act*[13] "to be responsible and accountable governments with respect to matters within their jurisdiction [as set by the Province] and each municipality is given powers and duties under [*the Municipal Act*] and many other Acts for the purpose of providing good government with respect to those matters" (*Municipal Act*; 2006, c. 32, Schedule A, s. 2). Much has changed, however, since the incorporation of the City of Toronto in 1834 and many people question the relevance of the *Act* today.

In 1834, the population of Ontario was just under one million and the urban/rural percentage split was 14:86 (see Appendix D: Ontario's Urban-Rural Composition Shift). By 2001, the GTA's population had grown to 5 million and reversed its urban/rural split to 85:15. Municipalities - especially those concentrated in the Greater Golden Horseshoe (GGH) - now

[12] When inter-provincial issues arise (such as when pipelines or power lines cross provincial boundaries) then jurisdiction shifts to the Federal Government who is then responsible for planning and regulation.
[13] And also *City of Toronto Act*

drive the Ontario economy and the provincial government is increasingly turning to municipalities to fill the provincial coffers. This new reality was not envisioned by the Canadian 'founding fathers' (Lorinc 2006) and the Province now faces a conundrum. While increased revenue from growing municipalities is desired, increased growth typically results in increased energy demand which necessitates increased supply. Yet the Province, the historical provider of energy infrastructure, faces a fiscal shortage to fund these capital intensive infrastructure projects and is increasingly looking to municipalities as their source of revenue. Climate change and environment issues are demanding a reduction in GHG emissions and the urban footprint. In light of this conundrum and acknowledging that the demographic, economic and environmental trends warrant a change, the Province has shifted its policy and has widened the jurisdiction of municipalities, in effect handing over more responsibility to them. Further, the fiscal squeeze has resulted in the government encouraging more public-private partnerships.

Within the energy realm, the Province has been encouraging municipalities to consider renewable and alternative energy options and to promote a culture of conservation. (See Appendix C and E: Ontario Political and Legislative Support for SCEP). In light of this shift Ontario municipalities, traditionally excluded from the energy planning process, are now participating in and providing local leadership in the deployment of these measures. This Provincial invitation for municipalities to become more involved in power generation and related energy supply solutions is apparent in many forms. For example, the *Ontario Provincial Policy Statement* (2005, s.1.7.1, 13) promotes, "providing opportunities for increased energy generation, supply and conservation, including alternative energy systems and renewable energy systems… Planning authorities shall support energy efficiency and improved air quality through land use and development patterns which: promote compact form; and … promote design and orientation

which maximize the use of alternative or renewable energy, such as solar and wind energy". The 2005 Provincial Policy Statement (2005, s. 1.8.2 and 1.8.3, 18) continues,

> "increased energy supply should be promoted by providing opportunities for energy generation facilities to accommodate current and projected needs, and the use of renewable energy systems and alternative energy systems, where feasible…. *Alternative energy systems* and *renewable energy* systems shall be permitted in settlement areas, rural areas and prime agricultural areas in accordance with provincial and federal requirements."

The Ontario Growth Plan for the Greater Golden Horseshoe (GGH) notes "as the GGH grows, so will the overall demand for water, energy, air, and land. The ongoing availability of these natural resources is essential for the sustainability of all communities. This Plan recognizes and supports the role of municipal policy in providing leadership and innovation in developing a culture of conservation" (Ontario Growth Plan for the Greater Golden Horseshoe 2006, 30). Further the *Energy Conservation Leadership Act*, 2006 allows that public agencies (including municipalities) may be required to prepare an annual energy conservation plan.

The Ontario *Planning Act* encourages communities to create "community improvement project areas" where the definition of community improvement has been expanded to include the improvement of energy efficiency (Ontario *Planning Act*, s.28). Further it now mandates that, "in considering a draft plan of subdivision, regard shall be had, among other matters, to … the extent to which the plan's design optimizes the available supply, means of supplying, efficient use and conservation of energy" (Ontario *Planning Act*, s.24). (See Appendix F: Ontario Planning Structure and Legislative Framework overview).

The *Municipal Act* states, a "municipality may provide, arrange for or participate in an energy conservation program in the municipality to encourage the safe and efficient use and conservation of all forms of energy including, but not limited to: the improvement of an energy

system in a building; the substitution of one form of energy for another form of energy; the improvement of the capacity of a building to retain heat; the reduction of energy use through more efficient use of energy; and the shifting of electrical loads from times of high demand to times of low demand" (*Municipal Act,* 2001, c. 25, s. 147 (1); 2006, c. 32, Sched. A, s. 80 (1)).

As a direct result of these regulatory directives and enabling legislation, municipalities are now encouraged to work to change the energy planning process. No longer are municipalities just recipients of historical legacy systems, they can now be fully engaged planners, working to provide their constituents with alternative and renewable energy sources, independent of the grid, reducing their community's GHG footprint, working to adapt to climate change – in essence, creating a new energy paradigm.

4.3 Section Summary

The time is right for Ontario to create a new energy paradigm: demand needs to be curbed, supply needs to be adjusted to reduce GHG emissions and increase renewable energy and a shift in government policy suggests that the political will exists. The OPA has predicted an impending energy gap for Ontario and in response, under the direction of the Ontario Government, they have produced the Province's first *Integrated Power System Plan* (IPSP) that considers alternatives to the legacy system and includes more renewable energy. The policy shift directed by the Government of Ontario is promoting a green economy while increasing the role and responsibility of municipalities in energy conservation, renewable energy, coal phase out and climate change targets. The opportunity for SCEP exists and Ontario municipalities just need to act.

5: Sustainable Pickering Case Study

5.1 Background

In February 2005 the City of Pickering embarked on its journey to become the most sustainable community in North America when Council passed Resolution #31/05 declaring the City's support for the FCM Partners for Climate Protection (PCP) program and directing staff to complete milestones one through three. Since the June 2005 *"PCP Project Kick-off Meeting with Community Stakeholders and Partners"* event, Sustainable Pickering's journey has encouraged citizen participation and utility partnerships. Funded by FCM's Green Municipal Funds (GMF) and partnership investments by Enbridge, OPG and Veridian, workgroups formed to determine baseline emission levels, set targets and explore sustainability strategies. On Sustainable Pickering Day (May 2006) presentations were given by utility partners Bob Willard (Sustainability Advantage), *"The Business Case for a Sustainable Business / Municipality"*, Brian Feltmate (OPG), *"Sustainable Development is Smart Business"* and Susan Clinesmith (Enbridge) *"Sustainable Opportunities in the Commercial and Industrial Sector"*. In June 2006, Council adopted the *"City of Pickering Partners for Climate Protection Local Action Plan"* (LAP) recommending community GHG emissions reductions of 35 percent per capita and corporate reductions of 50 percent per capita by 2016 from the 1995[14] base-line levels – thus completing the first three PCP milestones. (See Appendix G: Pickering's LAP for more details).

Past City initiatives included the Official Plan review (1994), Healthy Community Initiative (1998), GTA Clean Air Membership (2002), Pickering Growth Management Study

[14] The Local Action Plan (2006, 11) explains that 1995 was selected as the Pickering baseline year, rather than 1990 as used in the Kyoto protocol for a number of reasons. Firstly, 1995 was the earliest year that community and municipal information was available. Secondly, for trend analysis, the latest energy and waste information was gathered for 2004. Thirdly, 2016 would provide a 10 year 'window of opportunity' from commencing the full program in 2007 based on PCP recommendations.

(2003) and the Climate Protection Plan and Sustainable Neighbourhood Development Guidelines (SND)[15]. The first phase of the sustainability journey began in 2005 with Local Capacity Building. The second phase developed a solid foundation identifying five objectives and 24 areas of interest (see Table 12), resulted in the completion of milestones one through three, and (in 2007) created the Office of Sustainability (Thomas Melymuk, Director). In June 2008, Pickering was recognized for their planning efforts winning the FCM-CH2M:Hill Sustainable Community Planning Award.[16]

Table 12 Pickering: Objectives and areas of interest

Objective 1: Healthy environment	
▪ Air	▪ Water
▪ Land	▪ Plants and animals
Objective 2: Healthy Society	
▪ Education / literacy	▪ Basic needs (food, shelter, access)
▪ Arts / culture / heritage	▪ Citizen participation / involvement
▪ Health / well-being / happiness	▪ Community safety / preparedness
Objective 3: Healthy economy	
▪ Employment opportunities	▪ Labour participation rates
▪ Income levels	▪ Business attraction / investment
▪ Innovation / entrepreneurship	▪ The rural economy
Objective 4: Responsible development	
▪ Buildings / structures	▪ Neighbourhoods
▪ Transportation system	▪ The City
Objective 5: Responsible consumption	
▪ Energy use	▪ Water use
▪ Food consumption	▪ Waste production / diversion

Source: Melymuk 2008, 14.

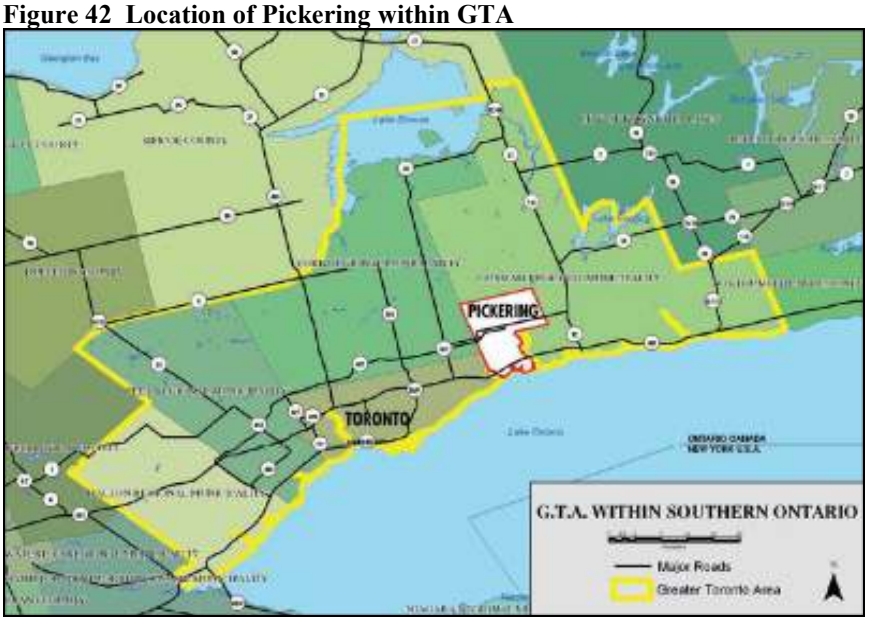
Pickering is a suburban community located within the Greater Toronto Area (GTA) with a land area of 22,652 hectares or 55,974 acres (see Figure 42). Its sustainability challenge is complicated by its designation as an 'urban growth centre' as per the *Places to Grow Act*

[15] Information on these and other Pickering initiatives is available online at: www.sustainablepickering.com/pdfs/spcmay22.pdf

[16] Further information on the FCM CH2M Hill 2008 awards is available at: http://www.zibb.com/article/3348820/Federation+of+Canadian+Municipalities+honours+municipal+excellence

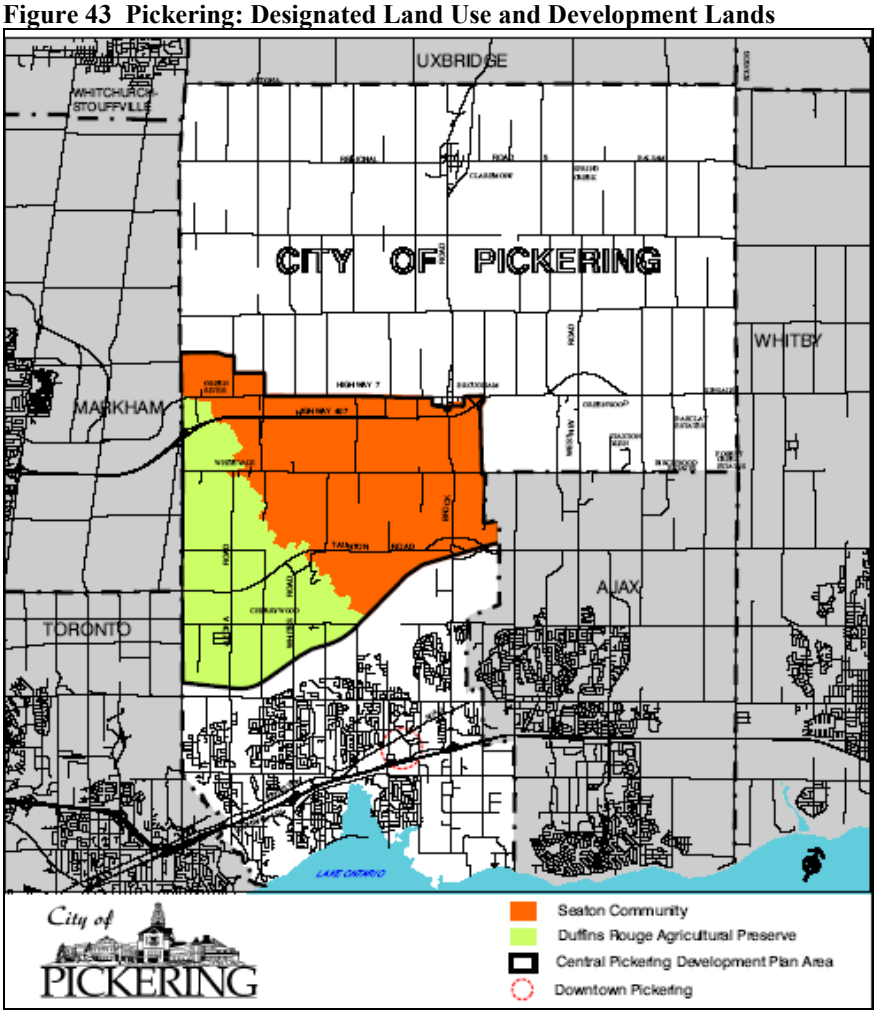
meaning that by 2031 or earlier, a minimum gross density target of 200 residents and jobs combined per hectare is planned for Downtown Pickering. Downtown Pickering will be an institutional and region-wide public services investment area, will become a high density major employment centre and will accommodate a significant share of population and employment growth. Pickering's total population is projected to increase by approximately 75% over the 1995 base year or 140,000 people by 2016 (Pickering LAP, 12) (see Table 13) with 35,000 new jobs and 70,000 additional residents planned for Central Pickering and the balance to be accommodated in the Seaton greenfield development along with proposed intensification of existing greyfields and brownfields (as illustrated in Figure 43). The Seaton lands represent a blank canvas on which Pickering can direct sustainable development. This allows for a clean start to develop building codes, by-laws and sustainability friendly *Planning Act* sections. One note of caution regarding the Seaton Lands however is that since they are owned by the Federal Government, complexity increases as negotiations regarding these lands involves three tiers of government.

Figure 42 Location of Pickering within GTA



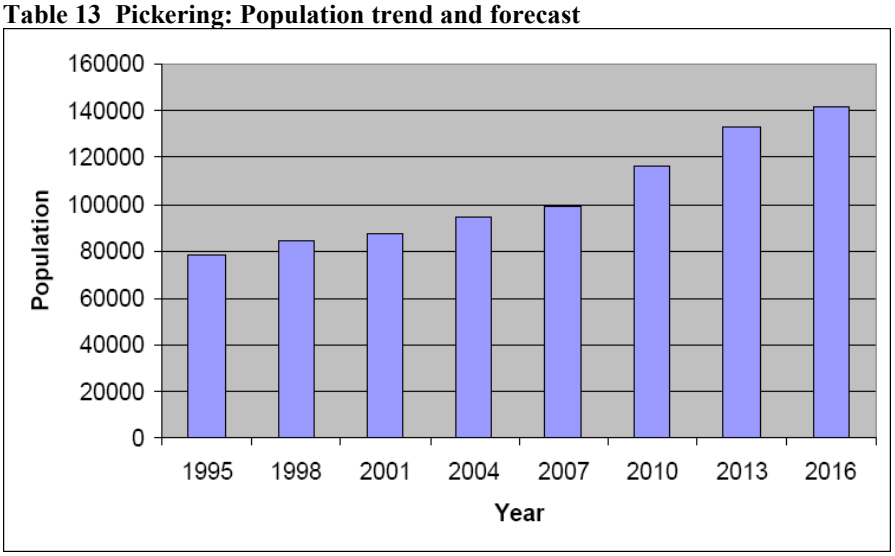
Source: Pickering website

Figure 43 Pickering: Designated Land Use and Development Lands



Source: Pickering website

Table 13 Pickering: Population trend and forecast



Source: Pickering LAP 2006, 12

5.2 Adaptive Management

Pickering utilized adaptive management as a tool in its sustainability quest and in a presentation to FCM delegates, Melymuk credits adaptive management as contributing to Pickering's success through its continuous improvement cycle (see Figure 44). Oregon State also endorses this approach, noting that while facilitating change is difficult, adaptive management is useful as it "has the attribute of being flexible, encouraging public input, and monitoring the results of actions for the purpose of adjusting plans and trying new or revised approaches" (Oregon State website).

The concept of adaptive management to direct change in complex systems was developed by Holling in the late 1960s. It is defined as a systematic process for the continuous improvement of management policies and practices through learning from the outcomes of operational programs and adaptive management is most effective in its 'active' form, that is utilizing management programs designed to experimentally compare selected policies or practices and by evaluating alternative hypotheses about the system being managed. Contrasted with conventional management techniques, it acknowledges the complex and undefined nature of change involved in a sustainable journey, the uncertainty about what policy or practice is 'best' for a given management issue and allows for flexibility along the journey as new inputs are received and findings revealed.

Adaptive management is related to Trist's 'learning organizations' and Argryis' and Waddell's single, double and triple-loop learning styles in that it channels and directs organizational efforts to achieve goals within complex systems with ever-changing realities however it differs in recognizing communities as holistic eco-systems.

Figure 44 Adaptive Management - Sustainable Pickering

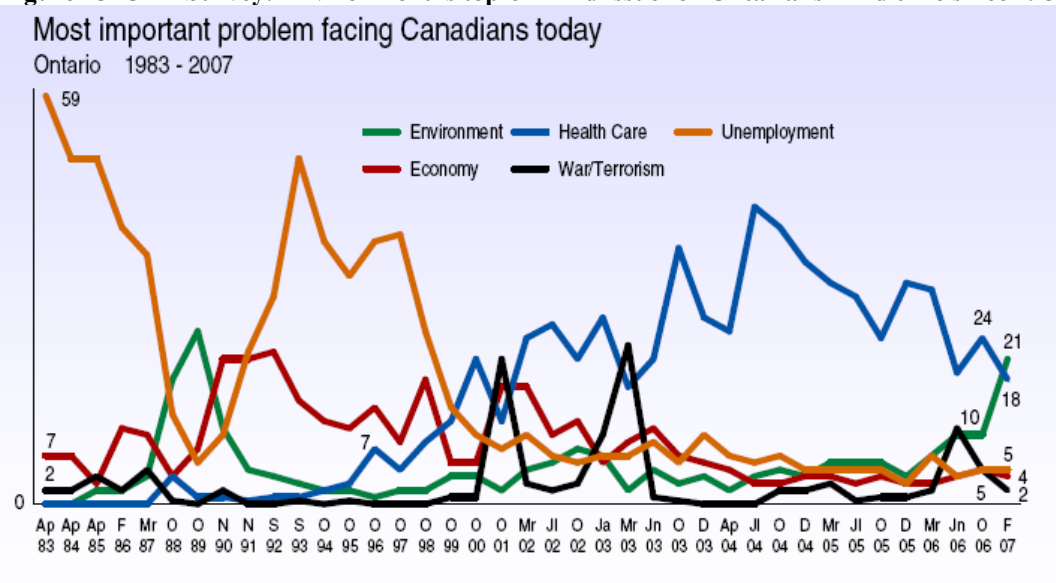
Source: Sustainable Pickering FCM Conference 2008

5.3 Energy and Environment – OPA Market Research

While Enbridge provides Pickering's natural gas service and Ontario Power Generation (OPG) and Veridian provide electricity, OPA oversees energy planning. As Pickering becomes involved with SCEP, municipal planners will need to understand and appreciate OPA research findings in order to implement the LAP. Some important findings are: consumers recognize the importance and benefits of electricity conservation and their current focus is on cost savings; conservation is seen as the right thing to do, but few are ready to take full responsibility – the issue is 'known but not owned'; and citizens are looking to government for leadership on environmental issues (OPA Survey 2007, 69). Further, as shown in Figures 45-47, OPA research warns that while environment and climate change issues are top of mind with Ontarians today healthcare and economic issues can overshadow this depending upon shifting world realities; "energy (generally) and electricity (specifically) are not salient issues for most Ontario consumers" (OPA Survey 2007, 13); and electricity is still taken for granted (OPA Survey 2007, 69); but the research encouragingly notes that "environmental concerns underlie priorities for

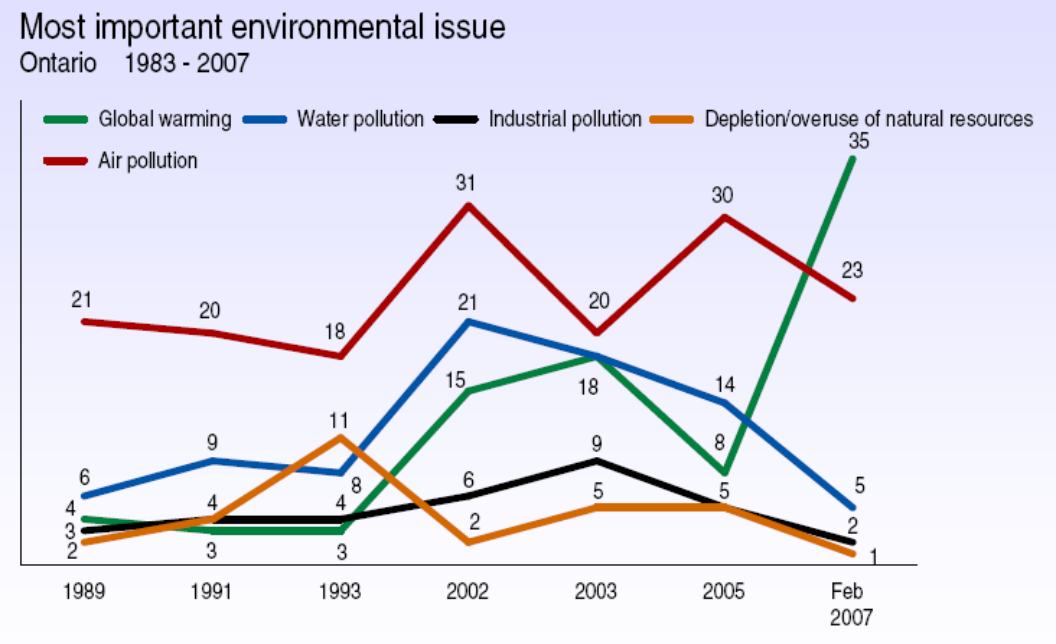
new supply options" (OPA Survey 2007, 17). To achieve sustainability's triple-bottom line municipalities will have to succeed in balancing these competing interests.

Figure 45 OPA Survey: Environment is top-of-mind issue for Ontarians - 2nd time since 1983



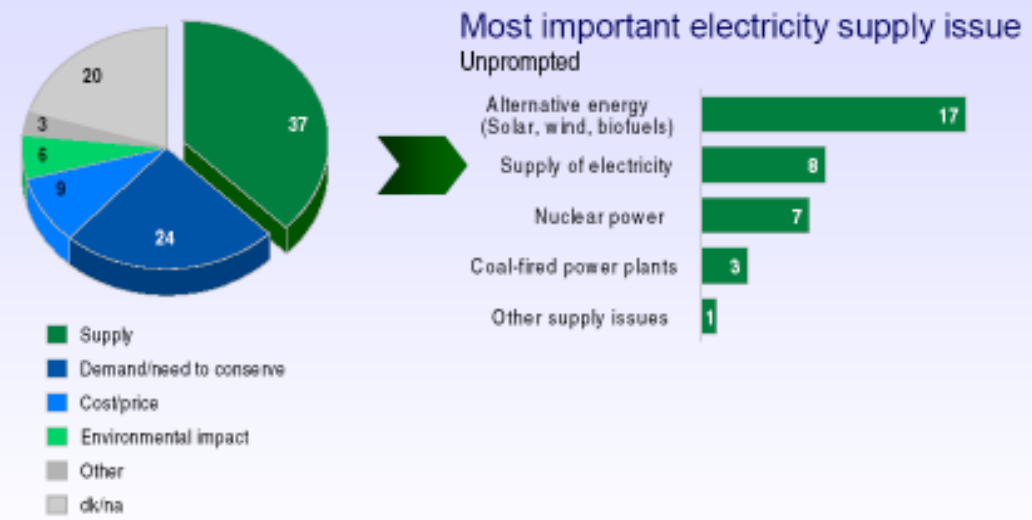
Source: OPA Survey 2007, 9.

Figure 46 OPA Survey: Climate change is top environmental issue for Ontarians.



Source: OPA Survey 2007, 10.

Figure 47 OPA Survey: Supply (and source) of electricity is most important to Ontarians



Source: OPA Survey 2007, 17.

5.4 Partnering with utilities

As communities make the transition to new energy paradigms, business as usual (BAU) models will no longer be feasible and new rules and opportunities will emerge creating mutually beneficial municipal-utility partnership opportunities – as is the one between Pickering and Enbridge. Since the Sustainable Pickering journey began, Enbridge has participated in finding solutions, identifying alternatives to current legacy system and introducing innovative demand-side management (DSM) programs – many incorporated into the LAP. Enbridge must consider how to grow and prosper under a new paradigm – importantly in Hoffman's words (Harvard Business Review) it needs to "be at the table". Enbridge's senior management and key staff intuitively acknowledge this reality and an analysis (see Appendix H: Enbridge SWOT analysis) reveals that a strategic opportunity to engage in SCEP does exist and that it may be a lost opportunity to not participate.

Enbridge is a natural gas provider, and while this is a "cleaner fossil fuel", it remains a fossil fuel and it is therefore of finite supply and not renewable. Continuing to operate under a

"business as usual" model in a changing regulatory, business and social environment – plus a carbon-constrained future - is short-sighted. In response, Enbridge should re-position itself in the marketplace as an ***energy*** distribution company, not just a natural gas distribution entity; including offering energy management services to certain sectors and incorporating more renewable energy into their product offerings. To some extent this has already happened as demonstrated by Enbridge Inc.'s foray into wind in Alberta, Saskatchewan and Ontario. (See Appendix I: Canadian Wind Energy Developers). However, this necessitates a reframing of their corporate mission statement and necessitates partnering with municipalities – identifying and exploring options in depth and then acting upon opportunities that offer growth in revenues and earnings for Enbridge.

To make the transition from conventional energy supply to SCEP, to make sustainable energy a reality and in order to provide the new range of services required, new collaborative partnerships between governments – starting at the municipal level - and businesses - ranging from entrepreneurial private entities to regulated monopolies - need to be formulated. It is important that Pickering continue to develop strategies and a business case in order that stakeholders (municipal and corporate) adopt the vision and engage in the transition. Just as governments and communities need to work with business for the common good, so do businesses need to work with municipalities.

5.5 District Energy

In January 2007 FVB Energy Inc. released their "District Energy Pre-feasibility Assessment" report for Pickering, noting that if the City took a pro-active role, it could be an effective strategy for integrating sustainability into Central Pickering's development. FVB's

assessment of the DE potential in Central Pickering weighed five considerations: density, size of buildings, distinctions between district heating and district cooling, propensity and risk and potential heat sources. Their initial conclusion was that at present "the development pattern for Central Pickering would not support economically viable DE designated to serve all types of buildings in all neighbourhoods from one central plant" (FVB 2007, 21). Their recommendation was to assess DE potential by neighbourhood, noting that economic paybacks would be long-term at best (with losses in earlier years) as densities are not high enough. This is a problematic conclusion for several reasons. Firstly, environmental gains result but are not factored in to economic pay-back calculations given current accounting methods. Secondly, often-times engineering consultancy mandates are to evaluate viability in terms of engineering hardware payback times only rather than considering the wider more complex sustainability criteria discussed earlier. Thirdly, consultants are not necessarily providing unbiased conclusions as they often have vested interests in the legacy systems.

5.6 Learning from Other Community's Approaches

Three examples of SCEP are introduced below: Markham District Energy, the Guelph Community Energy Plan, and Drake Landing (colloquially known as "Okotoks"). They have been chosen for illustration in this document since Pickering would like to learn from other initiatives and represent, in order: an exploratory project; an example of a municipality that has incorporated SCEP concepts into its long-term community planning; and a working demonstration project. Importantly, each is worthy of further consideration beyond the limited recognition given here.

Two innovative projects by ***Markham District Energy*** are the energy from waste facility study and district energy capital expansion project. The first investigates the economic and technical feasibility using fuel extracted from organic waste for its district heating system (blends biogas with natural gas to fuel a DE plant). Three benefits are anticipated: local waste solution, a means of hedging natural gas volatility and high costs, and lower GHG emissions to improve air quality. It is also anticipated to work in conjunction with other waste management plans and anaerobic digester projects. The second is a large greenfield urban planning project in Markham's downtown centre (covering 988 acres and 15 million square feet of industrial, commercial, and residential space). The facility will utilize a CHP plant and high efficiency boilers, reducing natural gas usage by 25% and resulting in lower GHG emissions. (See Appendix J: Markham District Energy for more details).

Drake Landing is not just a theoretical example - it is a working demonstration project located in Okotoks, Alberta 25 kilometers south of Calgary. Here, the Town of Okotoks championed the vision of making its community more sustainable by being its own energy generator. Partnered with ATCO Gas, United Communities and Sterling Homes, Drake Landing's officially ribbon-cutting occurred on June 21, 2007. The community has fifty-two homes, each with two roof-top solar thermal collectors, district collectors on their garages and a community geo-exchange borehole thermal energy storage "BTES" field to store the collected heat. Bill Wong, the lead project manager for Okotoks is working with other communities to roll this, and other technologies, out across Canada. (See Appendix K: Drake Landing, Okotoks for more details).

The ***Guelph Community Energy Plan*** developed through a consultative process that formed a Consortium and reviewed initiatives from around the world in order to establish an

accurate benchmark as a starting point for measuring success going forward. They reviewed plans for community sustainability from the UK, Sweden and Canadian locales. "The Consortium recognized the importance of a Vision around energy and water that would not be changed year-to-year, but would survive in intent, spirit and working literally from one generation to the next" (Garforth 2006, 23). Focusing on GHG emissions intensity targets, the plan accommodates a 55% *increase* in population out to 2031 while *reducing* GHGs per capita by a similar 55%. (See Appendix L: Guelph CEP for more details).

5.7 Summary

Pickering's sustainable journey officially began in 2005 with Council's commitment to the ICLEI framework although the community's sustainability desire pre-dated the resolution. While Pickering has engaged utility partnerships, completed milestones one to three, used adaptive management techniques and laid a solid foundation, the implementation of the LAP remains a challenge. In addition to the Pickering case study this section provided three examples of successful municipal initiatives for the City's consideration and highlighted new areas of interest for Pickering as they implement their LAP and become more involved in community energy planning.

6: Findings for Discussion

Think globally, act locally is an often heard mantra very applicable to climate change and energy issues. Climate change is a global problem that requires action at a local level, stated with the understanding that while the actions of one community alone would not solve a global problem, collectively the actions of a network of municipalities would. One of the guiding

research questions for this paper asks, "How can a municipal approach be an effective approach?" Municipalities are home to a large, and growing, percentage of urban residents nationally and globally. The PCP network has 155 members from communities all across Canada representing 65% of the national population or 75.5% of Ontario's population (see Figure 48). There is a "growing consensus that sustainable development must be achieved at the local level if it is ever to succeed on a global basis" (ICLEI, 1996 as cited in Mikolajuk and Yeh 2000, 15). As The Natural Step proponents conclude "communities are the building blocks of our society and are therefore an obvious place to begin to address the challenge of sustainability" (The Natural Step website).

Figure 48 Percentage of population represented by PCP network

Province / Territory	Number of PCP Participants	Population Represented	% PCP	Province Population (StatsCan 2007)	% PCP of Prov	% PCP of CDA
Alberta	14	2,168,291	9.9%	3,474,000	62.4%	6.6%
British Columbia	49	3,535,426	16.1%	4,380,300	80.7%	10.7%
Manitoba	8	746,343	3.4%	1,186,700	62.9%	2.3%
New Brunswick	14	262,747	1.2%	749,800	35.0%	0.8%
Newfoundland	7	192,513	0.9%	506,300	38.0%	0.6%
Northwest Territories	3	21,211	0.1%	42,600	49.8%	0.1%
Nova Scotia	10	443,992	2.0%	934,100	47.5%	1.3%
Nunavut	1	5,236	0.0%	31,100	16.8%	0.0%
Ontario	**38**	**9,672,336**	**44.1%**	**12,803,900**	**75.5%**	**29.3%**
Prince Edward Island	1	32,245	0.1%	138,600	23.3%	0.1%
Quebec	7	4,473,756	20.4%	7,700,800	58.1%	13.6%
Saskatchewan	2	339,300	1.5%	996,900	34.0%	1.0%
Yukon	1	21,405	0.1%	31,000	69.0%	0.1%
Total	**155**	**21,914,801**	**100.0%**	**32,976,100**		**66.5%**

Source: compiled from PCP and Statistics Canada on-line information, March 2008.

Municipalities have the power to make a difference for their communities. "Local authorities can regulate, advise, and facilitate action by local communities and stakeholders, and have considerable experience in addressing environmental impacts within the fields of energy management, transport, and planning, and many have already undertaken innovative measures and strategies to reduce their impact on climate change" (Lambright, Changnon, and Harvey, 1996; Collier, 1997; Collier and Löfstedt, 1997; Angel et al., 1998; DeAngelo and Harvey, 1998; McEvoy, Gobbs, and Longhurst, 1999; Wilbancks and Kates, 1999; Association of American Geographers, 2005, all quoted in Betsill and Bulkeley 2004, 477). "In short, local governments will be critical players in any attempt to implement national and international policy imperatives to reduce emissions of greenhouse gases, and have a significant role to play in climate protection in their own right" (Betsill and Bulkeley 2004, 477).

In the content and policy analysis section of this paper legitimacy was established for municipal participation in community energy planning. The Province has invited municipalities to become involved and to explore a jurisdiction previously relegated to another tier. The analysis reveals however, that while the invitation has been extended the authority granted is in its infancy.

Municipalities are closely connected to their constituents: being directly accountable to them they risk being voted out of power in the next election if they do not set and keep an approved mandate. Initiating a sustainability journey through Council resolution gives staff the authority to pursue it as a municipal objective. Creating an "Office of Sustainability" and hiring a Director with a planning background provides Council with expertise to guide the sustainability journey. In Pickering this office (the first in Ontario)[17] coordinated with citizens, utilities and other staff including planners in the Planning Department. They led workgroups and facilitated

[17] Melymuk presentation at 2008 FCM conference, page 16.

discussions culminating in a Local Action Plan and explored CEP initiatives such as District Energy with consulting companies and with utilities.

Municipalities are motivated to participate in CEP through risk management and infrastructure provision. Communities are vulnerable to the effects of climate change including larger more intense storms – Katrina (devastating New Orleans and affecting business assets – such as Enbridge's in the Gulf of Mexico), the 1998 winter ice storm (affecting the hydro-electric transmission system between Ottawa and Montreal and leaving communities without power for days) and the August 2003 blackout (that shut down the energy distribution system of the North American northeastern region leaving many of the continent's largest cities without power). While rebuilding infrastructure is expensive, building it right influences energy consumption and extends asset life (infrastructure lasts 100+ years) long into the future. Municipalities have the ability to incorporate standards into planning processes as in the case of East Gwillimbury where the Energy Star standard has been adopted into the planning and development system. Another interesting option is using Section 28 of the Planning Act, which recently expanded the interpretation of "Community Improvement Project (CIP) Area" to include energy. Used creatively, this modification may allow tax incentives to be extended to CIPs - allowing municipalities to influence the future energy considerations in a designated CIP area.

A new energy paradigm is essential in a post-carbon world and it needs to incorporate renewable and "green infrastructure". Municipalities can take the lead in making their communities more environmentally friendly by reducing GHG emissions through SCEP initiatives. Collectively, they can make a difference on a national and global scale.

6.1 What are the opportunities and constraints of using CEP in creating sustainable communities?

The opportunities of using CEP in creating sustainable communities are substantial but depend upon the definition of sustainability embraced by the community, the degree of transformation desired, the political will to make it happen, risk, tolerance to change and community willingness to modify behaviour. "On a global scale [community energy planning (CEP) or management (CEM)] can be an important element in the greenhouse gas emission reduction strategy" (Jaccard, Failing and Berry 1997, 1065). Vob notes, "energy is central to achieving the interrelated economic, social and environmental aims of sustainable human development" (Vob 2006, 15). Researchers, in general, agree that energy is integral to land use planning, building design, infrastructure provision and job creation and that community energy plans can contribute environmentally, socially and economically and can be an effective mitigation and adaptation strategy.

O'Riodan's research reveals that understanding competing definitions of sustainability is important to understanding different future visions and then to understanding different paths leading to fulfilling them. Vob, too, concludes "if we are to realize this important goal the development of a consensus of what sustainable development means in concrete terms and how to make the concept of sustainable energy provision operational is a prerequisite" (Vob 2006, 165). This variability is also apparent in the terminology of proposed solutions: community energy management, planning and systems – CEM, CEP, CES, etc. As Steer and Wade-Gery (1993) note each definition of sustainable development offers a number of possible modifications to the development process and different reasons for them (Steer and Wade-Gery, 1993 as cited in Mikolajuk and Yeh 2000, 16).

Lack of consensus is problematic in determining the "degree of transformation" that a community will choose. Adopting a 'shallow' definition (i.e. Brundtland) maintains the status quo, allows conservation and efficiency programs but limits transformational new paradigm opportunities (embracing holistic design through innovations such as district energy, waste to energy and eco-industrial parks that include renewable energy) that more progressive environmentalists desire. Reform measures, such as demonstration and 'one-off' projects using renewable energy and green technologies, are reluctantly preferred over status quo approaches (felt to be 'too little, too late') but do not go far enough. Even worse, communities can get caught up in debates and arguments rooted in different interpretations of sustainability resulting in no action at all. As Vob concludes (2006, 165) "changing the energy system in the direction of sustainability is no simple matter" but it can and must be done.

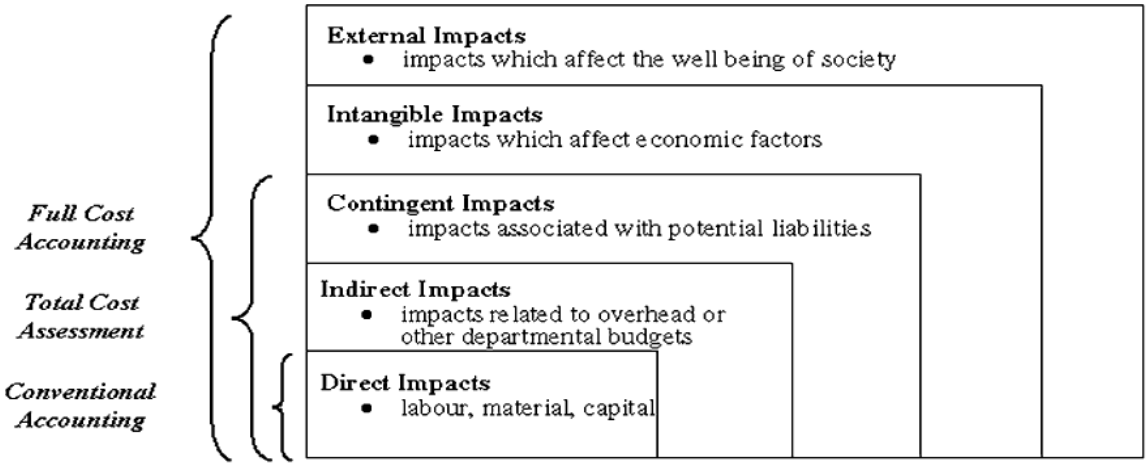
Clift (2008, 268), addressing UK energy policy, concludes that the overall message - that climate change is a real threat and that action to mitigate it is possible - is widely accepted but he questions the political will to take the necessary action. As the OPA research shows, environmental and climate change issues now rank at the top of Ontarian's concerns. Politicians, therefore have citizen's backing to pursue green initiatives. Betsill and Bulkeley (2004) note that climate change has been localized with the problem reframed from globally to locally significant as policymakers increasingly recognize that climate protection is consistent with some local issues and objectives. They stress that, "local governments must pass a resolution or other formal declaration of their intention to address the threat of global climate change" (Betsill and Bulkeley 2004, 477). Pander (2008) concurs, elaborating that detailed next steps must be spelled out in the resolution as it gives more substance than general, sweeping, broad statements.

Dale (2001) cites governance and 'gridlock' (in the planning and implementation processes for decision-making) as major barriers to the implementation of sustainable community development. She explains that the 'gridlock' faced by Canadian communities "is not due to lack of research, knowledge and information residing in communities, but rather has arisen as a result of the solitudes, silos and stovepipes" that characterize the research, business and governance sectors (Dale 2001). She continues "it is multi-faceted and involves, among other things, a lack of coherent dialogue; congruence between political levels; political will, and a 'sustainable development' ethos among various government levels and community stakeholders" (Dale 2001). Others refer to "fundamental disconnections - between federal, regional and local governments, between rural and urban communities, and critically, between the business and research communities" (Bradford 2002; Dale 2001).

Ultimately citizens must modify their behaviour and therefore, the underlying challenge lies in human nature. Sumi (2007, 70) presents three characteristics of the climate change problem: it is global in the scale of its influence; its main effects will occur in the future (knowledge of its dangers is increasing but consequences are not universally recognized); and some freedom limitations in maximizing economic returns must be accepted now to solve the problem later. Getting people to take action towards sustainability necessitates a real or perceived "sacrifice" for a future benefit and this requires a moral, ethic, passionate or compelling emotional argument. Children and grandchildren are most peoples' link to the future and family connection is ultimately the most compelling interest in motivating environmental preservation. Personalizing the future, making environmental concerns a personal concern - not someone else's problem – is the bottom line for paradigm change to be embraced.

Municipalities need to identify business opportunities and convince business to become more environmentally conscious – offering financial incentives, the opportunity of being involved in the initial stages of projects or partnerships. GHG emissions indices and registries can calculate and track the cost or "full price" that we are paying for energy and full costing accounting can quantify externalities allowing these costs to be internalized, assigning a true cost over the entire lifespan and allow for more accurate long-term rates of return. Accounting principles too need to be reviewed as costing conventions, pricing options and subsidies mask true costs leading to misguided analysis and incorrect conclusions. As a result, innovative and radically different systems are deemed "not profitable". Full scope costing and Life Cycle Assessment (LCA) are ways to justify CEP as a worthy alternative paradigm (see Figure 49). (See Appendix M: SCEP Funding Sources for other innovative SCEP funding mechanisms).

Figure 49 Costing approaches and impacts



Source: Sheltair 2001, 38.

Additionally, society's preoccupation with short-term rates of return needs to be rethought. Technological changes require long-term timeframes – something shareholders with short-term motives and politicians dealing with short-term election cycles find uncomfortable.

6.2 What can we learn from Pickering's sustainability journey with regards to using CEP to create more sustainable communities?

Sustainable Pickering's journey has only just begun. While stakeholders/proponents such as Mr. Melymuk are pleased to have received a FCM planning award that recognizes Sustainable Pickering's foundational work, few projects have been completed to date. Mr. Melymuk notes that the implementation stage will be challenging and that many of the "Next Steps" from 2006 remain outstanding (see Table 14). At the FCM conference Mr. Melymuk shared Pickering's 'lessons learned' (see Table 15) and he welcomed input from conference delegates and participants on the implementation stage.

Table 14 Pickering: LAP Next Steps

Next Steps

There are many implementation suggestions in the action plan, however the following next steps are the most pertinent:

1) Obtain funding for the creation of new full-time position to coordinate all sustainability programs outlined in this action plan plus other relevant initiatives under the Sustainable Pickering program. Private sector funding could potentially be ascertained for this position on a three year contract.

2) Develop a phased implementation plan with estimated start-up costs and operating costs for each program.

3) Continue to engage stakeholders and potential funding partners for milestone 4 program implementation.

4) Develop funding strategies and applications for relevant programs.

5) Develop a budget for any of the above work that needs to be contracted.

Source: Sustainable Pickering LAP, 59.

Table 15 Pickering: Lessons learned

Source: FCM Conference presentation 2008.

In addition to Melymuk's Lessons Learned, the Pickering case study and research reveals other findings from which we can learn with regards to using CEP to create more sustainable communities. Each is considered in the following paragraphs.

The preparation of a LAP does not necessarily lead to an easy implementation of that plan. Mr. Melymuk explained that Pickering put together a sustainability program, a "journey" approach, not a rigorous plan. Programs or journeys are an alternative way of doing business. Sustainable Pickering did not start with just writing a plan, rather they prepared a report to council recommending three steps: first, communicate the goal; next, establish a foundation; and then implement the plan. Pickering chose a collaborative and participative course of action which was more fluid and flexible. They formed workgroups comprised of experts and local citizens. And, although they followed the PCP model and have completed the first three milestones, it was not a linear approach. Pickering followed an adaptive management approach based on a circular

model “Think, Act, Measure” (rather than plan, implement and measure). This is a new way of doing business for Pickering and requires different tools. It relies on community consultation and an integrative style.

Pickering’s LAP was designed to guide future development along a sustainable journey. While the FCM accepted the LAP, hindsight reveals that implementing it or moving forward on the sustainability journey by executing specific action-oriented projects is missing. To proceed, detailed costings of specific projects will need to be conducted. This may, in fact, be indicative that a step is missing in the ICLEI milestone framework (for example a milestone 3.5, analysis of specific projects supported by costings and a business plan) or it may be indicative of a critique of the Pickering LAP in that it seems to be lacking the required detail.

In reviewing the FCM website, no clear understanding of “implementation” is stated, and simply showing that actions are being taken is not enough. While Pickering is dedicated to “implementation”, an acceptable indicator of success is lacking. Pickering’s target is a community GHG reduction of 35% per capita and a corporate reduction of 50% by 2016 from 1995 levels. To be successful in achieving these goals, milestones along the way need to be established. Successes to each point should then be reviewed, with remaining work assessed to ensure that the ultimate goal will be achieved.

Betsill and Buckeley put forward several reasons for municipalities to select the FCM / ICLEI framework. Many are consistent with the reasons that Pickering selected the ICLEI model. It allowed Pickering to access GMF funding (See Appendix M: SCEP Funding Sources). It allowed partners to participate - these partners being Enbridge, OPG and Veridian (and importantly, they bought into the vision and furthered the initiative). It also allowed for benchmarking – Pickering was able to compare themselves against other communities. The FCM

program brought legitimacy to Pickering's initiatives and allowed the team to receive outside recognition. It allowed Council to show other communities that they were working on a sustainability initiative resulting in positive publicity within the family of Canadian municipalities.

Another observation on the ICLEI approach is that it is presented as a progressive list – milestones one through five, yet PCP states that a municipality can start with any milestone on the list which infers a feedback loop. If this feedback loop exists in the PCP framework it is not stated or presented visually which is important in considering whether the PCP framework incorporates Argryis' double or triple loop learning or if it is single loop learning. FCM infers that a sustainability journey is never complete. Yet, once a municipality has completed step five, there are no other steps. Perhaps ICLEI needs to clarify their five milestone framework to consider it as a "first lap" which when completed triggers a re-evaluation of what has been achieved and that then sets up another 5-step plan for a "second lap" of this sustainable journey. This suggests that ICLEI can learn from Pickering's adaptive management approach (Figure 44), the ICSP model (Figure 34) and Ottawa's "Municipal environmental evaluation process" (Figure 33) that include feedback loops.

Lastly, in considering the "planner as expert" – the Pickering experience makes one consider the evolution of the planner and "expert at what?" OPPI too, recognizes that the planning profession needs to reconsider the role of planners - not just to be just technical knowledge experts giving advice but to be facilitators and experts at communication, public relations, adaptive management and other techniques.

Interestingly Pickering is proposing to market an 'energy cluster' promoting education, training and energy employment in the Durham Region in order to generate jobs and stimulate

economic development. Pickering has been recognized for their planning efforts towards sustainability and has produced their LAP yet implementing it remains elusive. Facilitating this transformation is the next step. They have engaged partners, adopted DSM measures, used adaptive management techniques, looked at forward-thinking DE systems yet still find the next steps difficult. While this is progressive, some problematic obstacles remain. One stumbling block being the nuclear power plants located in Pickering's 'backyard'. To Lovins soft and hard energy paths are divergent and mutually exclusive and not only is the dismantling of these nuclear plants not a topic for conversation, additional plants are proposed at Darlington. Another is that for most environmentalists Pickering's adoption of the Brundtland's definition does not go far enough. Determining the political will, assessing the community's receptivity to what degree of change they desire and agreeing on the new paradigm vision is a necessary prerequisite to pursuing studies and assessing alternative courses of action on the path to sustainability.

6.3 What needs to be done towards achieving our goal of using CEP to create sustainable communities?

In answering what needs to be done towards using CEP to create sustainable communities, the findings in this section briefly consider three technological strategies, the evolving role of the planner and how planners can facilitate collaboration between municipalities and utilities.

6.3.1 Operational Rules and Key Principles

"The energy landscape provides the dominant assumptions, values and deeply rooted socio-economic trends at a given period of time" encapsulating the key 'philosophy' behind

policy-making trends" (Shackley and Green 2007, 223). "In that sense [it] can be said to reflect the dominant perception of 'problems' and the ways to resolve those problems (the 'policy paradigm' or 'discourse coalition')" (Shackley and Green 2007, 223). Thus changing the energy landscape necessitates changing the underlying philosophy and policy. Misaligned and competing policy needs to be reformulated: "provincial policy for environmental protection is undermined by municipal development plans that sprawl into farmlands and greenspace and increase the need for private automobile commuting (Slack 2002), impacting on federal Kyoto agreements" (Dale 2001, Slack 2002). Two policy approaches are recommended by Betsill and Bulkeley: "those that attempt to reduce the use of energy through shaping the urban form, such as reducing the need to travel; and those that address energy use through design, for example, through the use of energy efficiency standards and the inclusion of renewable energy measures" (Betsill and Bulkeley 2004, 487). Importantly, planners' tools can influence and promote both these approaches.

Eco-centric approaches must be backed by policy and given more weight than techno-centric approaches. Techno-centric proponents (usually those with high stakes in the current regime such as Sheik Yamani) claim that it is necessary to invent a new mechanism to deal with scarcity of 'carrying capacity' to absorb emissions since they believe that "the future of fossil hydrocarbons will be constrained not by their availability but by the capacity of the biosphere to adapt to the emissions resulting from their use, specifically carbon dioxide. … The driver for change in energy technology is therefore the effect of the emission, not limited supply" (Clift 2007, 263). Yamani asserts "the stone age did not end because we ran out of stones" (Clift 2007, 263). A better approach is provided by Mikolajuk and Yeh (2000, 16) who suggest designing ecologically-oriented 'rules' to guide people toward sustainable development, such as:

> "a given renewal resource cannot be used at a rate greater than its reproductive rate. Otherwise it will become depleted. Strict controls on the use of nonrenewable resources are necessary to prevent the possibility of depletion. Substitutions and new technologies can help conserve scarce resources. Abatement measures should be taken to reduce pollution as well. The amount of pollution emissions should not exceed the assimilative capacity of the environment."

Daly, former chief economist for the World Bank, proposes three operational rules for sustainable development: renewable resources must be used no faster than the rate at which they can be regenerated; non-renewable resources must be used no faster than renewables can be put in place as substitutes; and pollution and wastes must be emitted no faster than natural systems can absorb them, recycle them, or render them harmless" (Rowles and Gibson 2008, 5).

The US Department of Energy (DOE) lists seven programs based on three key principles that can guide communities through CEP initiatives. These three principles include: conservation and efficiency; renewable energy and green power and economic growth through reinvestment of energy savings (lowered utility bills) into the local economy; and increased investment in green power related goods and services. (See Appendix N: Community Energy Key Principles for US DOE programs).

6.3.2 Technological Strategies

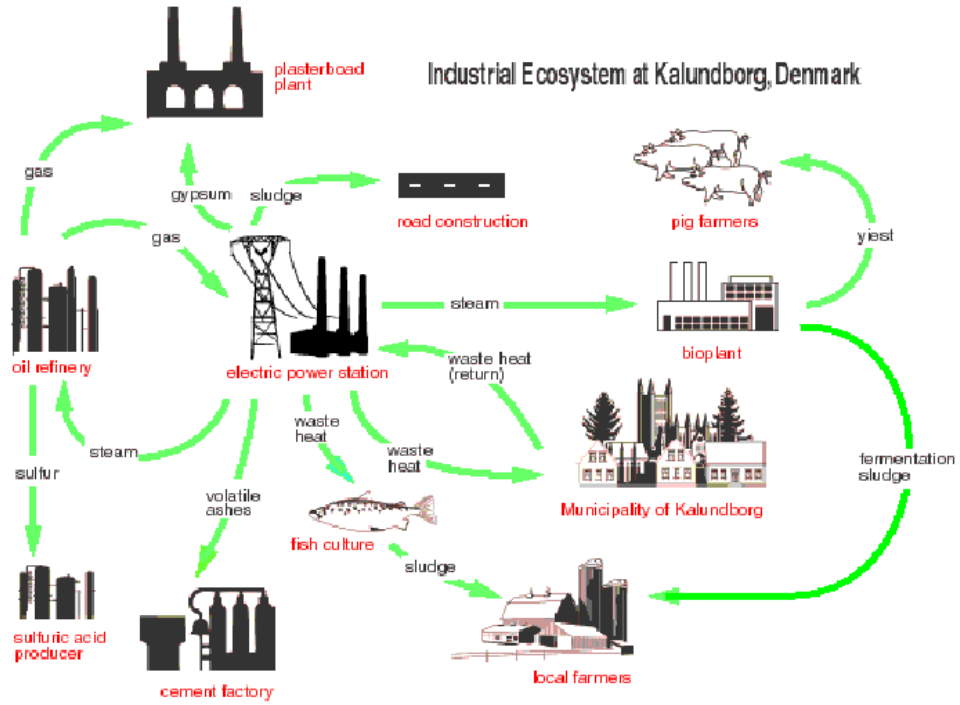
Three innovative techniques are briefly considered in this section for Pickering's consideration: eco-industrial parks, waste to energy systems including anaerobic digesters, and District Energy systems incorporating renewable energy. This is intended as an overview only and each is worthy of extensive further research.

Eco-Industrial Parks (EIPs) "aspire to zero emission or closed loop manufacturing and the total elimination of wastes via exchanges of inputs and outputs" (Hudson 2007, 830) and Hudson cites the Kalundborg EIP in Denmark (Figure 50) as a pre-eminent example. He explains that five industrial companies collaborated for mutual economic and environmental benefit, closing material loops by exchanging different kinds of byproduct. In this way, they sought to convert byproducts that might otherwise have been deposited in the environment as polluting wastes into valuable inputs into the production processes of adjacent companies. Hudson (2007, 829) notes that EIPs successfully emulate nature's adaptive processes adjusting their behaviour accordingly as they:

1. Take a holistic view of their economic environment and identify potential network partners;
2. Create interdependencies and engage in various resource exchanges – closing materials loops via recycling, recovery or reuse of wastes and enhancing eco-efficiency.
3. Discover new products and processes, suggesting that companies seeking eco-efficiency gains may become important spaces of innovation, knowledge creation and learning.

As Hudson observes these considerations are not new. For example, back in 1920 Talbot noted "waste must be forthcoming in a steady stream of uniform volume to justify its exploitation, and the fashioning of these streams is the supreme difficulty" (Talbot, 1920, cited in Scharb 2001, 22 and Hudson 2007, 830). Eco-industrial developments are most feasible in big densely populated regions which meet three criteria: balance between demand for and supply of byproducts by compatible firms in close proximity, close individual connections or institutional frameworks reducing transaction costs; and regulatory regimes that encourage collaborative inter-firm relationships rather than disposal of byproduct wastes.

Figure 50 Industrial ecosystem at Kalundborg, Denmark



Source: http://newcity.ca/Media/Kalundborg.gif

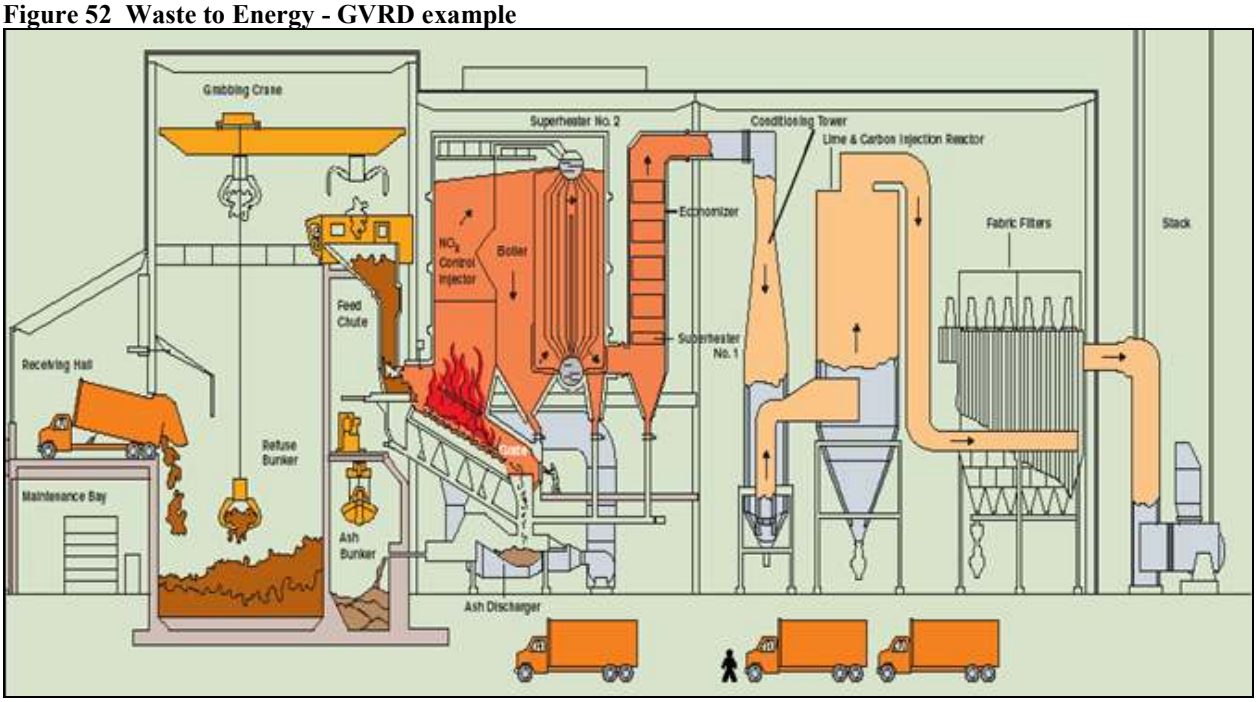
Wong (2008) suggests that waste to energy systems including anaerobic digesters (illustrated in Figure 51) is another technological strategy that works well in conjunction with eco-industrial parks and renewable energy to increase energy efficiency and reduce GHG emissions.

Figure 51 Anaerobic Digester using CHP

Source: Wong and Snijder 2007.

A working example of a waste to energy facility (WTEF) is located in Burnaby, B.C. (see Figure 52). El-Rayes (2006) and the GVRD (2007) explain that, since opening in 1988, the plant processes about 20% of the lower Mainland's garbage (turning approximately 280,000 tonnes of garbage into 900,000 tonnes of steam) a portion of which is then sold to a nearby paper recycling facility, helping to eliminate the use of fossil fuels and providing local economic and environmental benefits.[18]

Figure 52 Waste to Energy - GVRD example



Source: El-Rayes 2006.

Hughes[19] concludes that District Energy (DE) systems can lower GHG emissions and increase energy security especially in jurisdictions that rely on higher fossil fuels as a percentage in their energy mix. Waste heat from thermal plants generating electricity can be captured and

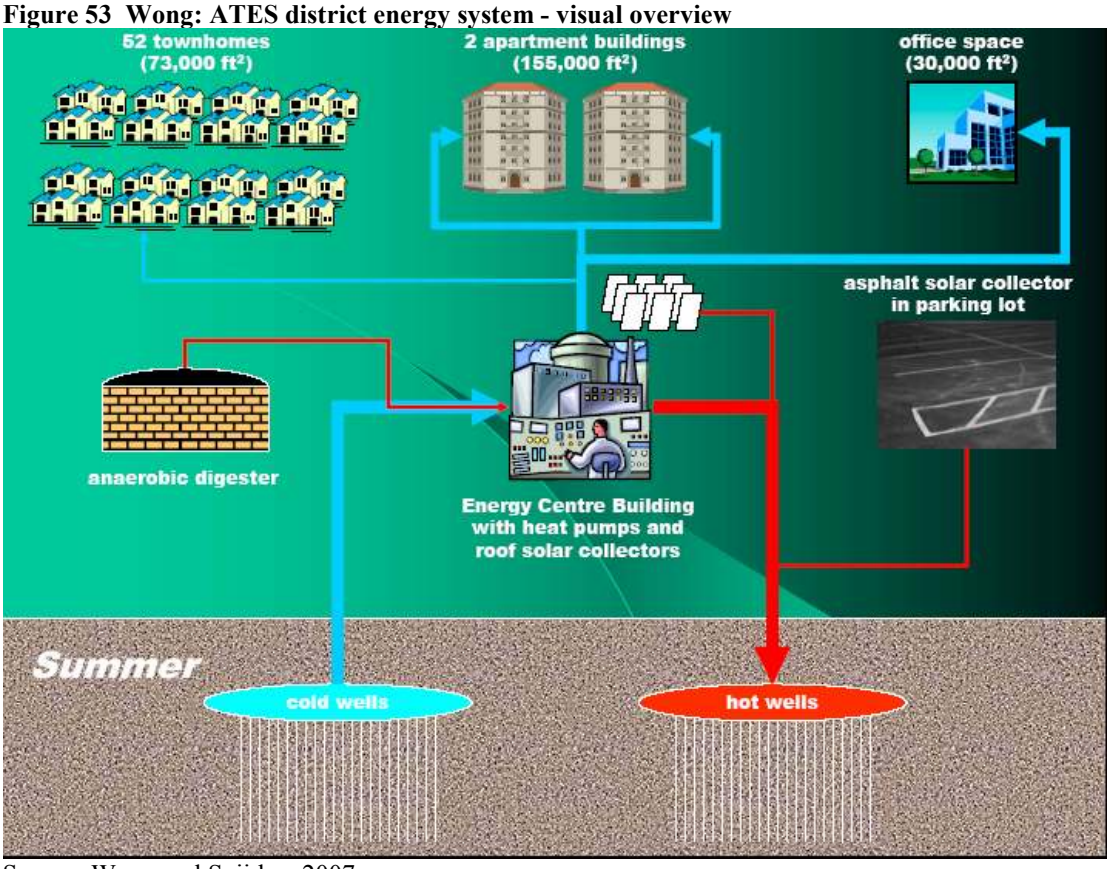
[18] Further information is available at: www.gvrd.bc.ca/recycling-and-garbage and http://public.metrovancouver.org/about/publications/Publications/WasteEnergyFactsheet.pdf

[19] Professor Hughes: Dalhousie University. Further information is available at: http://delh.electricalandcomputerengineering.dal.ca/enen/2008/gm_03_11.html

used in DE systems to supply heat to buildings within a community. DE systems eliminate the need for individual heating/cooling systems in each building and instead the heating/cooling is drawn from a central cogenerated heating source that can replace ones previously run on fossil-fuels.

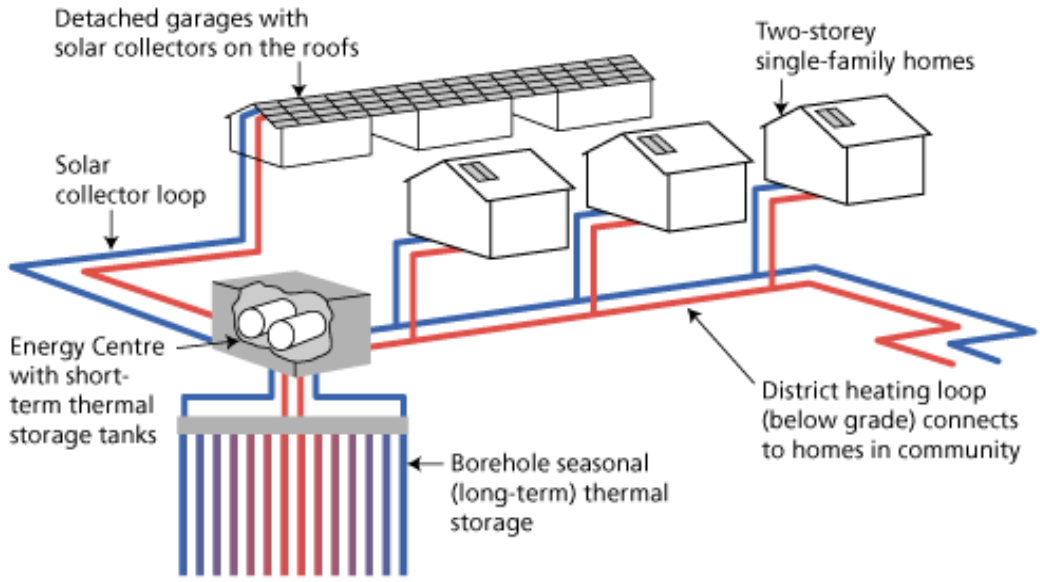
As Wong (2007) explains, DE systems can include underground thermal energy storage (UTES) technology – two system types being: aquifer (ATES) currently being considered in some GMF funded feasibility studies and illustrated in Figure 53 and borehole (BTES) as used in Okotoks and illustrated in Figures 54-56. (See Appendix M: Drake Landing Okotoks).

Figure 53 Wong: ATES district energy system - visual overview



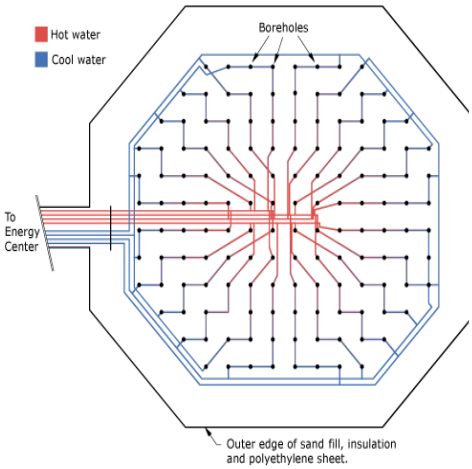
Source: Wong and Snijders 2007.

Figure 54 Okotoks: BTES district energy system with solar seasonal storage



Source: Okotoks website.

Figure 55 Okotoks: Aerial view of BTES system



Source: Wong and Snijders 2007.

Figure 56 Okotoks: Sideview and finished view of BTES system

Source: Wong and Snijders 2007.

6.3.3 Evolving the Role of the Planner

The findings in this section evolved from the following research question: "how must the role of the planner evolve to further the efforts of communities to achieve a goal of using community energy planning to become more sustainable?" Planners are the stewards of cities – desiring to make them great places in which to live, work and play. By putting forward long term visions, drawing on the varied histories of city development worldwide, and by analyzing and gathering information to appreciate current day issues, planners seek to use their professional expertise in solving today's urban problems. In addition they seek practical input and the real experience of citizens in formulating solutions.

Today's planning challenges differ from those of the past. Where preventing the outbreak of cholera around drinking water pumps in London was yesterday's challenge, planners today are concerned about lowering GHG emissions and resolving climate change issues. Problems have become more complex and simply applying what was previously thought of as a "solution" does not guaranty a remedy. When the industrial revolution had just begun, cities were smaller and less complex. Where planners faced pollution from single point factory sites they could enact zoning and separation of land-uses to allow privileged citizens to escape conditions of air pollution. Where cholera outbreaks were linked to contaminated water pumps, improving water and sewage conditions allowed city residents to obtain safe drinking water. However, now air pollution is related to greenhouse gas emissions which are causing climate change affecting not just a local area, but the global realm. These complex problems require new ways of thinking.

Planners, as stewards of our cities, are in a unique position to see the connections between planning policy, energy policy and climate change policy and can make a difference if their visions and solutions are presented and respected. But this is not an easy task. Planners will need to become involved in areas not previously considered their realm – including energy provision. Fortunately municipalities are being encouraged to promote energy conservation and innovative alternative approaches to energy provision. Since urban design influences energy consumption and is the realm of municipal planners, planners too have been invited to participate. Municipal planners have the training, skills and connections to local citizens, business and elected representatives. Their skills are transferable to the SCEP process and are essential to new partnerships and the establishment of new processes. They are knowledgeable on urban planning issues (land-use, transportation, essential infrastructure and services) and are

experienced in facilitation and collaboration – key as SCEP will require new multi-stakeholder partnerships.

"A well-designed CEP process will involve the community, and encourage citizens to maximize energy and transportation efficiency, shift transportation modes to less energy-intensive ones, and utilize low-impact renewable energy resources, especially local resources where these are available" (West Coast Environmental Law website). In addition, municipalities should involve "energy utilities as direct stakeholders in developer negotiations and as strategic partners in official community planning processes" (Jaccard, Failing and Berry 1997, 1072). New collaborative partnerships will be required between government, business and community residents to create this new paradigm. It is a natural extension of the role of the planner to facilitate and collaborate with these new partners to navigate through the complexities of sustainable community energy planning. The result will be worth the effort: planners will aid in combating climate change, making our cities more sustainable and improving the quality of life for our community residents.

Planners are comfortable crafting, reviewing and critiquing many types of official documents, including Official Plans (OP), plans of subdivision, community improvement projects, coordinating with other municipalities and with conservation agencies such as the Toronto Region Conservation Authority (TRCA). Energy plans, climate change and air quality strategies are a natural extension of these and are a natural evolution of the role of the planner. In the near future, planners will routinely be involved in creating SCEPs. In order for this to happen, though, it is important to consider if energy concerns are part of the planners job description and under whose jurisdiction energy management and planning falls in each municipality. Planners can influence and shape growth towards a sustainable future but they

must have energy and GHG emission reductions concerns embedded in their job descriptions, be accountable for them and be rewarded for taking action in order for them to do so. Council can help in this regard by passing resolutions to establish that all public officials have direct responsibility for this as a community goal. This would also help alleviate the silo effect noted by Dale.

Jaccard, Failing and Berry (1997, 1071) state implementation will require changes to planning processes and public policy in both energy and urban planning with particular emphasis on partnerships between community planners, utilities (energy generation and distribution) and regional planning authorities. The following two tables present more specific ways for planners to contribute to SCEP. Table 16 focuses on planning initiatives while Table 17 focuses on policy initiatives that can facilitate maximum participation by municipalities.

Table 16 Energy Research Group: Strategies for planners to further SCEP initiatives

Area	Strategies
▪ Land use	
	▫ The identification of areas for compact and nodal development in community plans.
	▫ Zoning for mixed use and intensification; density bonuses; transfer of development rights; and urban containment boundaries.
	▫ Green points system.
	▫ Annual awards system for innovative development.
▪ Greenspace	
	▫ Establish tree planting and naturalization programs.
	▫ Control tree cutting in the municipality and require tree protection permits or performance bonds during excavation, demolition or construction.
	▫ Require street trees in new development, in new surface parking lots, and on public rights of way.
	▫ Designate forested land in municipalities to remain free of development
	▫ Offer density bonuses and transfer of development rights to encourage preservation of forested areas in new development. Structure Development Cost Charges to encourage clustering.
	▫ Include tree planting or preservation in a "green points" system.
▪ Buildings	
	▫ Develop a Municipal Umbrella Program that promotes energy efficiency in new and existing commercial, residential and institutional buildings and site design. This program should emulate the characteristics of the Better Buildings Partnership in Toronto, which successfully integrates resources, skills, knowledge, and activities of various partners thus allowing the program to offer services and reach audiences that would not be possible if the partners were operating independently.
	▫ Promote energy efficiency in new building and site design (including microclimate landscaping and solar zones) through changes to, and the introduction of energy-aware municipal land use planning and development policies.
	▫ Net zero energy buildings.
	▫ Mandatory solar panel installations and use of renewable energy.

Source: Sadownik *et al*, 1999, iii.

Table 17 City of Toronto: Policy suggestions to facilitate maximum municipal participation

Area	Strategies
▪ Policy	
	▫ Require mandatory consideration of GHG in land-use planning and development processes.
	▫ Develop and disseminate standardized tools for evaluating the GHG consequences of development decisions at the scale of buildings, sites, neighbourhoods, communities and regions.
	▫ Establish a national framework for municipal monitoring, reporting, and performance targets for GHG emissions reductions.
	▫ Establish Federal / Provincial GHG performance criteria for infrastructure financing / grants.
	▫ Institute social marketing programs to promote alternative housing, transportation, and lifestyles.

Source: City of Toronto, 2007.

6.3.4 Facilitating Collaboration

The findings in this section evolved from asking the following research question: "how can the planner work with utilities and business to convince these energy providers to become

more environmentally conscious and participate in the CEP process?" Just as governments and communities need to work with business for the common good, so do businesses need to work with communities and government – this is now evident. Thus, to make the transition from conventional energy supply to SCEP, to make sustainable energy a reality and in order to provide the new range of services required, new collaborative partnerships between municipal governments and businesses - including utilities - need to be formulated. To succeed governments (and businesses) must prepare adaptation strategies that take long-term perspectives and these must be reflected in their community plans (and corporate business strategies). If they do not, municipalities (and business) will be ill-prepared to face the carbon-constrained marketplace that climate change and global warming is creating. Climate change brings both risks and opportunities: risks which must be mitigated and opportunities that offer community benefits and financial rewards. (See Appendix H: Enbridge SWOT Analysis).

Facilitating this transformation, however, will not be easy. As Waddell (2002) states, governments, businesses, utilities, planners and community groups all have differing mandates, timelines and stakeholder expectations (Figure 31 above). However, the key to success remains, keeping the overarching goal unified, harnessing the benefits that each contributes and smoothing out the tensions as they arise. Facilitating the process is necessary to get consensus on the vision, to map out the strategy and then to continue to move the process along while still meeting stakeholder expectations. Facilitating this collaborative effort will require that some key challenges (see Table 18) be overcome.

Table 18 Sadownik: Challenges to overcome

▪ There is often substantial opposition to proposals for innovative development at the neighbourhood level ('NIMBYism')
▪ Pricing structures and decision making processes do not consistently include external social and environmental impacts of different land use and development options which obscures the full costs of current approaches to urban development, and the complement of benefits from GHG reduction initiatives.
▪ Energy management may not be perceived to be a local objective, especially if municipalities are not aware of the financial, environmental and social costs of energy use, and do not have the expertise to address the issue.
▪ Provincial legislation in some jurisdictions may impede municipal adoption of energy efficiency and GHG management objectives.

Source: Energy Research Group, Sadownik et al 1999, ii.

7: Conclusion

Scientists have established a clear link between the burning of fossil fuels, smog, air pollution and climate change. Although this is a global problem, many nations now recognize that change will require local action. Energy is essential to the Western world's quality of life but current practices do not generate or use energy in an efficient manner. The challenge is to find solutions which will eliminate GHG emissions without diminishing its standard of living. Through the years, energy sources have shifted from wood to coal to fossil fuels. Now it is time for Ontario to include renewables such as wind and solar.

In terms of a human life span, our province's current electricity system is often viewed as having existed forever. However, more close consideration of this system in broader analytical terms clearly suggests that the manner that we currently power our cities is relatively new – an infant in geological terms. This observation suggests that there is no "deeply entrenched" system that we must keep and that better energy options can be developed if we adapt our thinking and frames of reference. As Albert Einstein famously stated, "we can't solve problems by using the same kind of thinking we used when we created them."

Environmentalists recognize that solutions are beyond the ability of any one sector to achieve alone thereby necessitating a multi-sectoral approach at a local level. Municipalities can make this happen and can create more sustainable communities – environmentally, socially and economically. Energy is an integrator and SCEP can contribute to the triple bottom line while mitigating and adapting to climate change and ensuring a more stable, reliable and local energy system.

In a carbon-constrained future, business will need to re-think corporate strategy in order to remain competitive in a changing environment. As Senator Gaylord Nelson states, "the economy is a wholly owned subsidiary of the environment" and the Stern Report highlights the economic disaster that will result if environmental issues are not given priority. Businesses need to become triple bottom line orientated.

As Barton (1990) notes land-use arrangements have a direct bearing on up to 70% of the energy consumed in Canada. Planners have a direct influence on these patterns and can influence future patterns through planning tools such as zoning, density, by-laws and building and site design. Energy efficient infrastructure further influences future energy consumption, due to its 100+ year lifespan. Planners understand sustainability and can incorporate energy planning into their analysis, design and process. Municipalities need to involve their planners and review their job descriptions to ensure responsibility for considering energy planning and sustainable community planning and they need to be rewarded for taking action towards sustainable community energy planning.

As Kenworthy, Girardet and Soleri (among others) assert a holistic approach incorporating closed-loop systems needs to be taken. Energy matters and municipalities need to consider energy choices within their sustainable community plans. Many municipalities,

including Pickering, are following the ICLEI / FCM model. Unfortunately while many communities have base-lined GHG emissions, set targets and created Local Action Plans, few have implemented them. This situation is exemplified in the City of Pickering case study selected for this paper. Municipalities need to become learning organizations, incorporating double and triple loop learning, in order to change and thereby operationalize sustainability initiatives.

There are many working models around the world from which we can be inspired to create our own new paradigm and also to inform new and enlightened policies for our federal provincial and municipal governments. Municipalities and local communities, in particular, must use their planning experts to act as facilitators to bring together government, local citizens and businesses to take the environment seriously, to create change and achieve more sustainable communities. As this paper suggests setting ecologically oriented rules such as those listed by Daly to guide communities toward sustainable energy systems and incorporating technological innovations such as eco-industrial parks, waste to energy systems including anaerobic digesters and district energy are a few ways in which to operationalize the SCEP vision.

8: Recommendations for further research

Sustainable community energy planning is an expanding area of interest and while research in many aspects has begun, much more is needed. For example, this paper briefly suggests three technological strategies: eco-industrial parks; waste to energy systems including anaerobic digesters; and district energy (DE) systems. Each is worthy of further research and

business case studies to entice corporations to pursue them. Studies on DE systems to further substantiate their efficiency on a community scale would also be worthy.

Operational rules must be developed for municipal resolution. Further work is also needed in reading and analyzing changes in legislation, By-Laws and Acts in order to remove barriers to energy-efficient initiatives and innovations and also to prepare Council to pass resolutions similar to the Energy Star standard passed in East Gwillimbury.

Another area for concentration is the concept of density. Determining rules around its use as a common measuring tool and benchmarking criteria would be useful. This would build on the research underway by the CHMC's studies of typical housing form densities and sizes of typical cities (Tables 9-10) and Energy Research Group's definition of development classes (Table 11). Density might then become a stronger guiding factor in designing urban layouts, in setting planning goals and also in understanding the impact that built form has on energy consumption.

Still further research is needed on how to develop job and education clusters around energy as Pickering would like to do with its proposed "EN3" cluster: incorporating energy, environment and engineering.

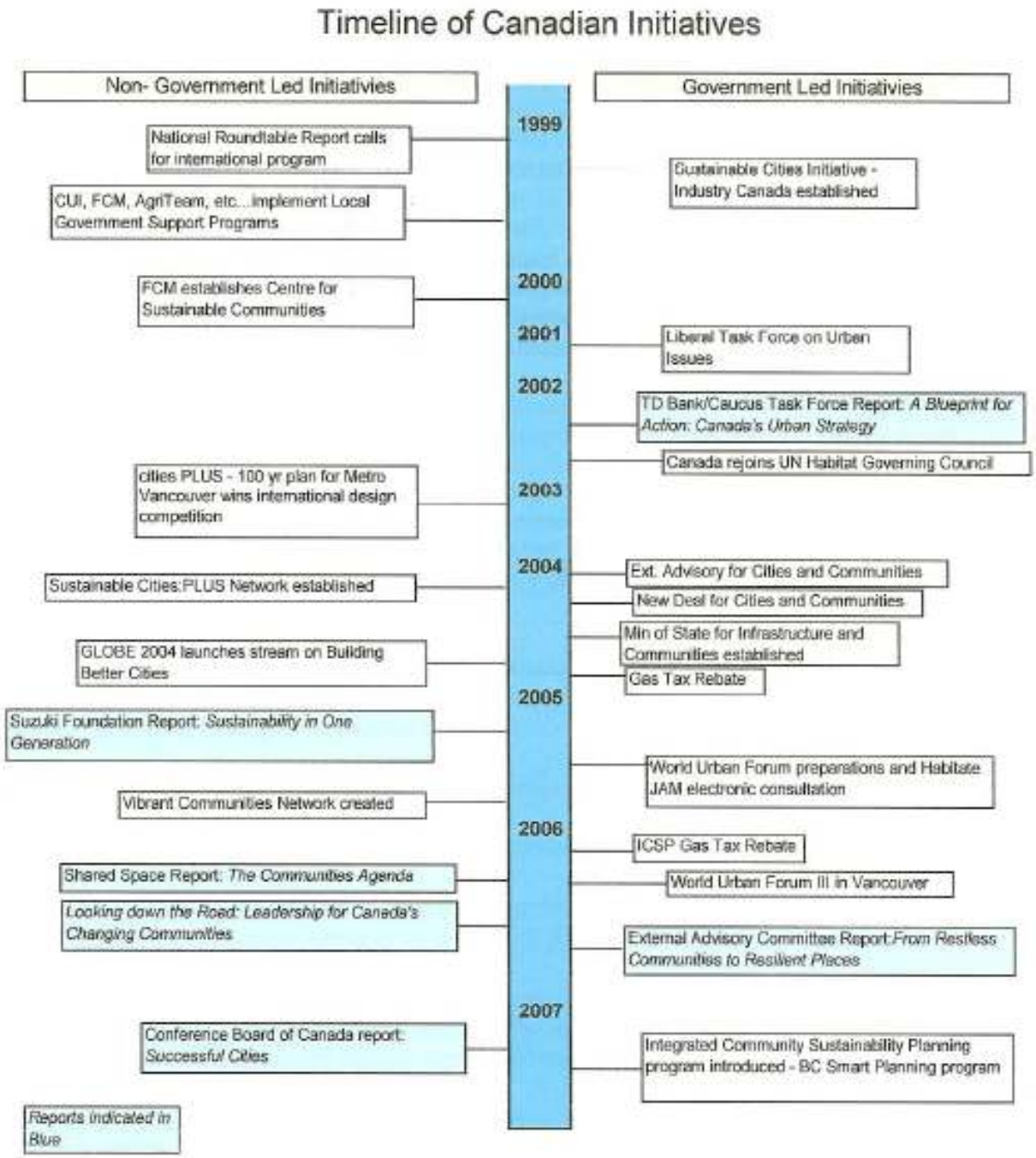
Appendix

Appendix A: Milestones in Sustainable Development Discussions

1789	Malthus' Essay on Population	Concern that Earth would not be able to support the exponentially growing number of people.
1817	Ricardo's Principles of Political Economy and Taxation.	Concern was that economic growth might be constrained by population growth and limited available resources.
1960s	Carrying Capacity	Presents the concept of Carrying Capacity.
1968	Club of Rome meets	Discusses the present and future predicament of the Earth and its finite resources.
1972	*The Limits to Growth* by Meadows et al is published.	Presents the deliberations at the Club of Rome 1968 meeting. Predicts that the limits of growth on Earth would be reached sometime within the next 100 years if the economy continued to expand at the current rate.
1972	UN Conference on Human Environment "Stockholm Conference"	Stresses the link between the deteriorating environment and the growth of poverty. Leads to the establishment of many environment ministries in OECD countries.
1974	*Atmosphere homoeostatis by and for the biosphere: the Gaia hypothesis* by Lovelock and Margulis.	Lovelock and Margulis postulate on interaction between the climate system and biosphere: accepts that human activity is substantial enough to disturb the natural radiation balance: via the emission of greenhouse gases and aerosols into the atmosphere; by changing the land use and land cover on the earth's surface; and material flows (accumulation of waste matter).
1976	Habitat I Conference – Vancouver, BC	Discussion of local environmental problems.
1985	*The Gaia Hypothesis* by Myers	(Formally proposed in 1973) – closely related to concepts of sustainable development and provides philosophical and theoretical insights into planetary life as a whole.
1987	World Commission on Environment and Development (WCED) "Brundtland Commission"	Gro. Harlem Brundtland, Prime Minister of Norway heads conference and publication of *Our Common Future.* It concludes that humanity cannot continue its rate of population growth and resource use.
1990	ICLEI International Council for Local Environmental Initiatives.	ICLEI founded by the International Union of Local Authorities and the United Nations Environment Program to represent the environmental concerns of local government internationally – now more than 815 cities, towns and counties. ICLEI promotes environmental and sustainable development initiatives within their decentralized framework and provides technical consulting, training, and information services to build capacity, share knowledge, and support local government. (ICLEI 2002).
1991	Loening develops the ECCO (enhancement of population carrying capacity options) computer system at the Centre for Human Ecology at the University of Edinburgh.	Aims to guide policy-making toward economic development that is more sustainable. Attempts to deal with trade-offs between population growth and standard of living in an agricultural context.
1992	United Nations Conference on Environment and Development (UNCED), held in Rio de Janeiro – "Rio Conference" or the "Earth Summit"	Presented five key documents: • *Agenda 21* – a framework for processes and actions that will bring the world closer to the concept of sustainable development. It has four sections each addressing a fundamental dimension of sustainable development: social and economic, conservation and management of resources for development, strengthening of major groups, and means of implementation. Energy is addressed in chapter 9

		(atmosphere). • The Rio Declaration on Environment and Development (The Earth Charter) • The Statement of Guiding Principles on Forests • The Convention on Climate Change • The Convention on Biodiversity
1992	*Beyond the Limits*, by Meadows et al,	Successor book to *The Limits to Growth* is published.
1995	Indicators for Sustainable Development (ISD) UN Department of Economic and Social Affairs (UNDESA)	Preparation work begins on indicators for sustainable development. While 58 indicators are generated, only 3 are energy related: annual energy consumption per capita, intensity of energy use and share of consumption of renewable energy resources. These indicators are in response to the UN Commission on Sustainable Development (CSD) and Chapter 40 of Agenda 21. (Vera and Langlois, 2007).
1996	UN General Assembly - Habitat II Conference – Istanbul.	"The conference had a broad agenda, and faced considerable challenges in reaching agreement on a definition of sustainable urban development, which was accepted by different countries and communities. Commentators suggest that environmental issues were neglected, in favor of more pressing issues concerning shelter and poverty." (Elander and Lidskog, 2000, 41).
2001	International Atomic Energy Agency (IAEA) presents indicators of sustainable development at the CSD-9.	Work begins (1999) on Indicators for Sustainable Energy Development (ISED). Two objectives: (1) complement overall UN Work Programme on Indicators of Sustainable Development; (2) foster energy and statistical capacity building need to induce energy sustainability.
2001	International Gas Union (IGU)	Establishes an international design competition calling for 100 year plans for sustainability.
2002	United Nations Conference on Environment and Development (UNCED) - held in Johannesburg (2002) – "Johannesburg Conference".	World Summit on Sustainable Development – Reviewed Agenda 21 (ten years after being adopted in Rio) to identify quantifiable targets and steps to further its implementation.
2005	ISED publishes Energy Indicators for Sustainable Development: Guidelines and Methodologies.	30 Energy Indicators for Sustainable Development (EISD) and provides guidelines and specific methodologies on how to construct them (Vera and Langlois, 2007, 877).
2005	David Suzuki Foundation	Launches *"Sustainability in One Generation"*
2005	Kyoto Accord	Protocol to the International Framework Convention on Climate Change with the objective of reducing greenhouse gases in an effort to prevent anthropogenic climate change. Negotiated in Kyoto, Japan in 1997 came into effect in 2005.

Sources: Mikolajuk and Yeh 2000; ICLEI 2002; Vera and Langlois 2007; and Elander and Lidskog 2000.

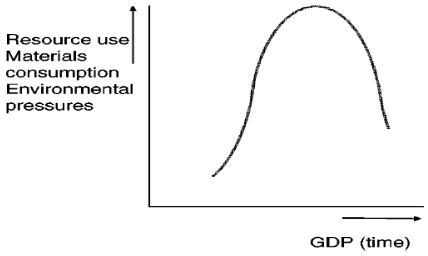


Source: Source: Seymoar 2007, 12.

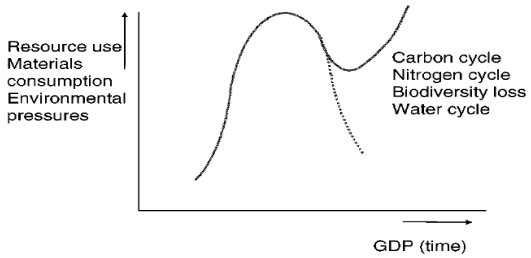
Appendix B: Kuznet's Curve

The Kuznets curve graphically presents the relation between economic growth and pressures on the environment. Until 1970 industrialized countries followed the upward path at which point the "signals of environmental degradation became very visible, such as the pollution of water (fish kills), air (visibility and effects on human health) and soils (pesticides and dumping of toxic wastes)" (Vellinga 2006, 157). Environmental problems necessitate multi-disciplinary approaches: economic, technological and behaviour-oriented. Economical approaches view the problem as "an inefficient allocation of (common) goods and ecosystem services and/or as a matter of imperfect markets in which prices do not reflect the value of the goods and services provided by nature" (160). Technologists view environmental problems as "a challenge and a trigger for technological innovation" (160). When technology overcomes the problem however, over-use can occur, rebound effects (price per unit drops encouraging more use) can happen and also the desire to be innovative decreases. Behaviour-oriented approaches are challenging in that they insist consumers change habits. Vellinga recommends that "in transformation research, the column representing the system should be the object of research while this system should be explored from the three horizontally listed perspectives". He notes that transformation research is research about system change and system changes requires an understanding of the interaction between technological change and societal change. According to Vellinga "surveys indicate that the general public considers sustainability as an overarching condition for production", "that the general public is not really willing to make sacrifices in terms of lifestyle changes" and "they expect producers and government to assure that the products and services introduced in the market do not cause serious and/or irreversible damage to the planet" (162).

Environmental Kuznets-curve hypothesis



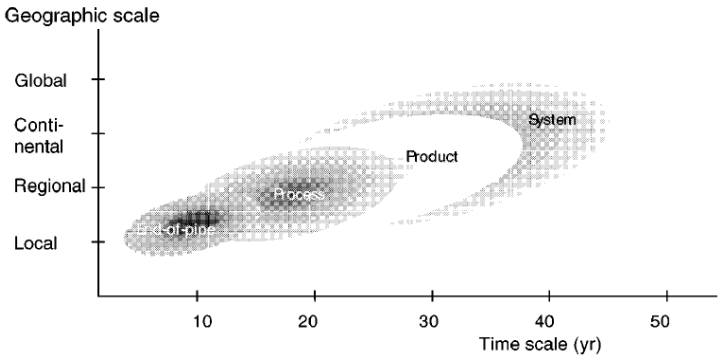
De-coupling (downward curve) and re-coupling (upward curve) between economic growth and resource use in OECD countries, in particular for those resources leading to global environmental change.



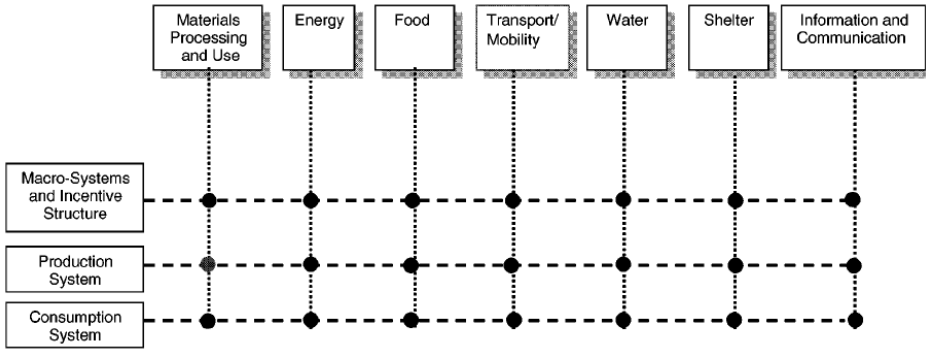
Development stages in environmental policy planning: A) Response Phase, B) Focus of attention, C) Main actors, D) Driving philosophy.

B)	End-of-pipe	Process	Product	System
C)	Specialists	Managers	Industry	Society
D)	Minimisation	Optimisation	Leap	Vision

Societal responses to the issue of environment, scales in time and space.



Tentative framework for industrial transformation research with research fields / disciplinary approaches on the horizontal rows and human needs / activities in the vertical columns. The "needs" (verticals) should simultaneously be explored from all three perspectives (horizontals).



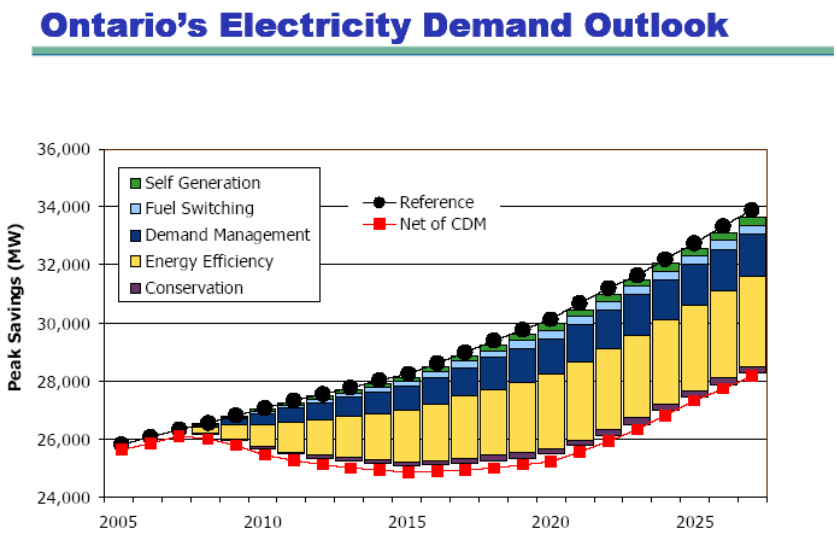
Source: Vellinga 2006.

Appendix C: Ontario - Political Support for SCEP

Political: The Hon. Dalton McGuinty, "Greening Ontario"

Provincial – Ontario Ministry of Energy – The Hon. Gerry Phillips

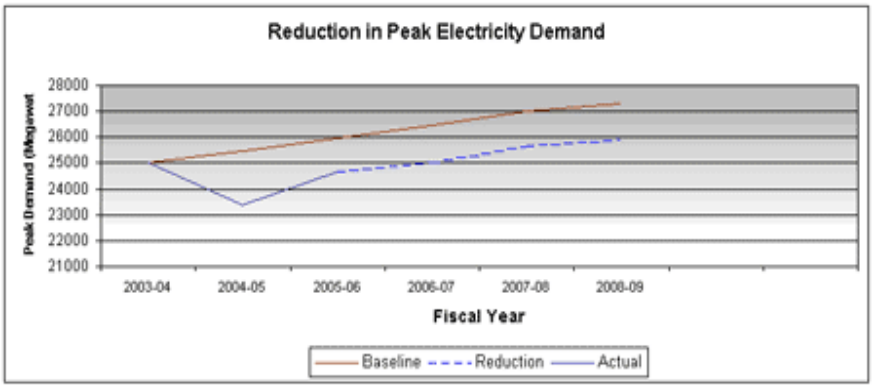
Responsible for developing the energy policy framework of Ontario and the ongoing review of energy provision in Ontario.



Currently reviewing the Integrated Power System Plan (IPSP) for the Province through to 2025. In his speech to the CanSIA Solar Conference attendees on November 20, 2007, The Hon. Gerry Phillips cited five priority area for the Ministry:

1) Conservation – committed to usage reduction of 6,000 MW representing 25% of current energy needs by 2025. As per the Ministry:

- "The target for 2007 is a peak electricity demand of 25,650 MW (5% below the projected peak demand of 27,000 MW).
- The ministry is on its way to meeting this target. The Chief Energy Conservation Officer's 2006 annual report estimates that projected peak demand had been reduced by 963 MW as of summer 2006."
- Smart Metering initiative – install 800,000 smart meters by end of 2007

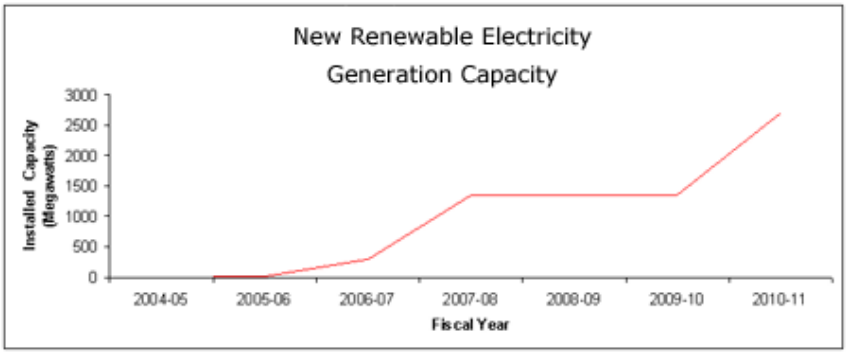


Source: Retrieved on November 27, 2007 from Ontario Ministry of Energy website: http://216.240.206.69/index.cfm?fuseaction=about.plan0708

2) Renewables – committed to doubling output by 2025. As per the Ministry's website: "the Province commits to contract for 5% or 1.350 MW of Ontario's electricity capacity from new renewable sources by December 2007 and 10% or 2.700 MW by 2010. Double the amount of electricity capacity from renewable sources by 2025, bringing the total to 15,700 MW.

- Through the ministry's Renewables RFPs, the OPA has contracts in place for 18 projects, which total 1300 MW of new renewable supply.
- As of March 31, 2007, nine projects totaling 412 MW had achieved commercial operation".

As per the Minister, this will be accomplished via increasing wind power production, SSM programs and the Renewable Standard Offer program.



Source: Retrieved on November 27, 2007 from Ontario Ministry of Energy website: http://216.240.206.69/index.cfm?fuseaction=about.plan0708

3) Refurbishment and construction of new nuclear facilities
(limit output to 14,000 MW)

4) Defining the role of Natural Gas in Ontario's future
"The government has also accepted the advice of the OPA that natural gas should only be used to meet peak demand in high-efficiency applications and to meet local reliability need when no alternative is available."
Retrieved on November 27, 2007 from
http://www.energy.gov.on.ca/index.cfm?fuseaction=english.news&body=yes&news_id=134

5) Elimination of coal plants by 2014.

Appendix D: Ontario - Urban-Rural Composition Shift

Population urban and rural, by province and territory
(Ontario)

	Total Population	Urban	Rural	Urban	Rural
	Number			% of total population	
Ont.					
1851	952,004	133,463	818,541	14	86
1861	1,396,091	258,192	1,137,899	18	82
1871	1,620,851	355,997	1,264,854	22	78
1881	1,926,922	575,848	1,351,074	30	70
1891	2,114,321	818,998	1,295,323	39	61
1901	2,182,947	935,978	1,246,969	43	57
1911	2,527,292	1,328,489	1,198,803	53	47
1921	2,933,662	1,706,632	1,227,030	58	42
1931	3,431,683	2,095,992	1,335,691	61	39
1941	3,787,655	2,338,633	1,449,022	62	38
1951	4,597,542	3,251,099	1,346,443	71	29
1956	5,404,933	4,102,919	1,302,014	76	24
1961	6,236,092	4,823,529	1,412,563	77	23
1966	6,960,870	5,593,440	1,367,430	80	20
1971	7,703,105	6,343,630	1,359,480	82	18
1976	8,264,465	6,708,520	1,555,945	81	19
1981	8,625,107	7,047,032	1,578,075	82	18
1986	9,101,695	7,469,420	1,632,275	82	18
1991	10,084,885	8,253,842	1,831,043	82	18
1996	10,753,573	8,958,741	1,794,832	83	17
2001	11,410,046	9,662,547	1,747,499	85	15

Note: The rural population for 1981 to 2001 refers to persons living outside centres with a population of 1,000 AND outside areas with 400 persons per square kilometre. Previous to 1981, the definitions differed slightly but consistently referred to populations outside centres of 1,000 population.

Source: Statistics Canada, Censuses of Population, 1851 - 2001.
Last modified: 2005-09-01.

Appendix E: Ontario - Legislative Support for SCEP

Ontario Ministry of Municipal Affairs and Housing - The Hon. Jim Watson

Provincial Policy Statement, 2005

Part I: PREAMBLE

The Provincial Policy Statement provides policy direction on matters of provincial interest related to land use planning and development. As a key part of Ontario's policy-led planning system, the Provincial Policy Statement sets the policy foundation for regulating the development and use of land. It also supports the provincial goal to enhance the quality of life for the citizens of Ontario.

The Provincial Policy Statement provides for appropriate development while protecting resources of provincial interest, public health and safety, and the quality of the natural environment. The Provincial Policy Statement supports improved land use planning and management, which contributes to a more effective and efficient land use planning system.

The policies of the Provincial Policy Statement may be complemented by provincial plans or by locally-generated policies regarding matters of municipal interest. Provincial plans and municipal official plans provide a framework for comprehensive, integrated and long-term planning that supports and integrates the principles of strong communities, a clean and healthy environment and economic growth, for the long term.

Land use planning is only one of the tools for implementing provincial interests. A wide range of legislation, regulations, policies and programs may also affect planning matters, and assist in implementing these interests.

1.7 LONG-TERM ECONOMIC PROSPERITY

1.7.1 Long-term economic prosperity should be supported by:

a) optimizing the long-term availability and use of land, resources, infrastructure and public service facilities;

b) maintaining and, where possible, enhancing the vitality and viability of downtowns and mainstreets;

c) promoting the redevelopment of brownfield sites;

d) providing for an efficient, cost-effective, reliable multi-modal transportation system that is integrated with adjacent systems and those of other jurisdictions, and is appropriate to address projected needs;

e) planning so that major facilities (such as airports, transportation/transit/rail infrastructure and corridors, intermodal facilities, sewage treatment facilities, waste management systems, oil and gas pipelines, industries and resource extraction activities) and sensitive land uses are appropriately designed, buffered and/or separated from each other to prevent adverse effects from odour, noise and other contaminants, and minimize risk to public health and safety;

f) providing opportunities for sustainable tourism development;

g) promoting the sustainability of the agri-food sector by protecting agricultural resources and minimizing land use conflicts; and

h) providing opportunities for increased energy generation, supply and conservation, including alternative energy systems and renewable energy systems.

1.8 ENERGY AND AIR QUALITY

1.8.1 Planning authorities shall support energy efficiency and improved air quality through land use and development patterns which:

a) promote compact form and a structure of nodes and corridors;

b) promote the use of public transit and other alternative transportation modes in and between residential, employment (including commercial, industrial and institutional uses) and other areas where these exist or are to be developed;

c) focus major employment, commercial and other travel-intensive land uses on sites which are well served by public transit where this exists or is to be developed, or designing these to facilitate the establishment of public transit in the future;

d) improve the mix of employment and housing uses to shorten commute journeys and decrease transportation congestion; and

e) promote design and orientation which maximize the use of alternative or renewable energy, such as solar and wind energy, and the mitigating effects of vegetation.

1.8.2 Increased energy supply should be promoted by providing opportunities for energy generation facilities to accommodate current and projected needs, and the use of renewable energy systems and alternative energy systems, where feasible.

1.8.3 *Alternative energy systems* and *renewable energy* systems shall be permitted in settlement areas, rural areas and prime agricultural areas in accordance with provincial and federal requirements. In rural areas and prime agricultural areas, these systems should be designed and constructed to minimize impacts on agricultural operations.

Ontario Ministry of Municipal Affairs and Housing - The Hon. Jim Watson

Planning Act

PART I: PROVINCIAL ADMINISTRATION

Provincial interest

2. The Minister, the council of a municipality, a local board, a planning board and the Municipal Board, in carrying out their responsibilities under this Act, shall have regard to, among other matters, matters of provincial interest such as,

(a) the protection of ecological systems, including natural areas, features and functions;

(b) the protection of the agricultural resources of the Province;

(c) the conservation and management of natural resources and the mineral resource base;

(d) the conservation of features of significant architectural, cultural, historical, archaeological or scientific interest;

(e) the supply, efficient use and conservation of energy and water;

(f) the adequate provision and efficient use of communication, transportation, sewage and water services and waste management systems;

(g) the minimization of waste;

(h) the orderly development of safe and healthy communities;

(h.1) the accessibility for persons with disabilities to all facilities, services and matters to which this Act applies;

(i) the adequate provision and distribution of educational, health, social, cultural and recreational facilities;

(j) the adequate provision of a full range of housing;

(k) the adequate provision of employment opportunities;

(l) the protection of the financial and economic well-being of the Province and its municipalities;

(m) the co-ordination of planning activities of public bodies;

(n) the resolution of planning conflicts involving public and private interests;

(o) the protection of public health and safety;

(p) the appropriate location of growth and development;

(q) the promotion of development that is designed to be sustainable, to support public transit and to be oriented to pedestrians. 1994, c. 23, s. 5; 1996, c. 4, s. 2; 2001, c. 32, s. 31 (1); 2006, c. 23, s. 3.

PLANNING ACT: PART IV: COMMUNITY IMPROVEMENT

Community improvement project area

28. (1) In this section,

"community improvement" means the planning or replanning, design or redesign, resubdivision, clearance, development or redevelopment, construction, reconstruction and rehabilitation, improvement of energy efficiency, or any of them, of a community improvement project area, and the provision of such residential, commercial, industrial, public, recreational, institutional, religious, charitable or other uses, buildings, structures, works, improvements or facilities, or spaces therefor, as may be appropriate or necessary; ("améliorations communautaires")

"community improvement plan" means a plan for the community improvement of a community improvement project area; ("plan d'améliorations communautaires")

"community improvement project area" means a municipality or an area within a municipality, the community improvement of which in the opinion of the council is desirable because of age, dilapidation, overcrowding, faulty arrangement, unsuitability of buildings or for any other environmental, social or community economic development reason. ("zone d'améliorations communautaires") R.S.O. 1990, c. P.13, s. 28 (1); 2001, c. 17, s. 7 (1, 2); 2006, c. 23, s. 14 (1).

Designation of community improvement project area

(2) Where there is an official plan in effect in a local municipality or in a prescribed upper-tier municipality that contains provisions relating to community improvement in the municipality, the council may, by by-law, designate the whole or any part of an area covered by such an official plan as a community improvement project area. R.S.O. 1990, c. P.13, s. 28 (2); 2006, c. 23, s. 14 (3).

Acquisition and clearance of land

(3) When a by-law has been passed under subsection (2), the municipality may,

(a) acquire land within the community improvement project area with the approval of the Minister if the land is acquired before a community improvement plan mentioned in subsection (4) comes into effect and without the approval of the Minister if the land is acquired after the community improvement plan comes into effect;

(b) hold land acquired before or after the passing of the by-law within the community improvement project area; and

(c) clear, grade or otherwise prepare the land for community improvement. R.S.O. 1990, c. P.13, s. 28 (3); 2001, c. 17, s. 7 (3).

Community improvement plan

(4) When a by-law has been passed under subsection (2), the council may provide for the preparation of a plan suitable for adoption as a community improvement plan for the community improvement project area and the plan may be adopted and come into effect in accordance with subsections (5) and (5.1). 2006, c. 32, Sched. C, s. 47 (1).

Grants or loans re eligible costs

(7) For the purpose of carrying out a municipality's community improvement plan that has come into effect, the municipality may make grants or loans, in conformity with the community improvement plan, to registered owners, assessed owners and tenants of lands and buildings within the community improvement project area, and to any person to whom such an owner or tenant has assigned the right to receive a grant or loan, to pay for the whole or any part of the eligible costs of the community improvement plan. 2006, c. 23, s. 14 (8).

Eligible costs

(7.1) For the purposes of subsection (7), the eligible costs of a community improvement plan may include costs related to environmental site assessment, environmental remediation, development, redevelopment, construction and reconstruction of lands and buildings for rehabilitation purposes or for the provision of energy efficient uses, buildings, structures, works, improvements or facilities. 2006, c. 23, s. 14 (8).

Criteria

(24) In considering a draft plan of subdivision, regard shall be had, among other matters, to the health, safety, convenience, accessibility for persons with disabilities and welfare of the present and future inhabitants of the municipality and to,

(a) the effect of development of the proposed subdivision on matters of provincial interest as referred to in section 2;

(b) whether the proposed subdivision is premature or in the public interest;

(c) whether the plan conforms to the official plan and adjacent plans of subdivision, if any;

(d) the suitability of the land for the purposes for which it is to be subdivided;

(e) the number, width, location and proposed grades and elevations of highways, and the adequacy of them, and the highways linking the highways in the proposed subdivision with the established highway system in the vicinity and the adequacy of them;

(f) the dimensions and shapes of the proposed lots;

(g) the restrictions or proposed restrictions, if any, on the land proposed to be subdivided or the buildings and structures proposed to be erected on it and the restrictions, if any, on adjoining land;

(h) conservation of natural resources and flood control;

(i) the adequacy of utilities and municipal services;

(j) the adequacy of school sites;

(k) the area of land, if any, within the proposed subdivision that, exclusive of highways, is to be conveyed or dedicated for public purposes;

(l) the extent to which the plan's design optimizes the available supply, means of supplying,

efficient use and conservation of energy; and

(m) the interrelationship between the design of the proposed plan of subdivision and site plan control matters relating to any development on the land, if the land is also located within a site plan control area designated under subsection 41 (2) of this Act or subsection 114 (2) of the *City of Toronto Act, 2006*. 1994, c. 23, s. 30; 2001, c. 32, s. 31 (2); 2006, c. 23, s. 22 (3, 4).

Planning Act R.S.O. 1990, CHAPTER P.13

Ontario Ministry of Public Infrastructure Renewal - The Hon. David Caplan

Places to Grow Act, 2005

What existing or pending legislation is there that could impact our green strategy?

- The Places to Grow (PTG) Act, (2005) stipulates that by the year 2015, all regions and counties, and single tier municipalities within Ontario would accommodate a minimum of 40% of new residential units within their already built-up urban areas. This has significant gas and electricity infrastructure implications, even though natural gas is not mentioned in the legislation.
- Over the next 5 years, more than $7.5 billion will be invested to improve infrastructure in the Greater Golden Horseshoe under the PTG Act. It is understood that during the province's extensive consultation process they met largely with municipalities, transportation authorities, but not with gas and electricity LDCs. The website for further information and where the plan resides is www.pir.gov.on.ca
- Outlines the growth plan of the Greater Golden Horseshoe (GGH) an area that includes the cities of Toronto, Hamilton, Kawartha Lakes, Guelph, Peterborough, Barrie, Orillia, and Brantford, the regional municipalities of Halton, Peel, York, Durham, Waterloo and Niagara and the counties of Haldimand, Brant, Wellington, Dufferin, Simcoe, Northumberland and Peterborough.
- The Greater Golden Horseshoe (GGH) is the fastest growing urban area in Canada and the third fastest growing in North America.

By 2031, close to four million more people and almost 2 million more jobs are forecast for the region.

Places to Grow Act, 2005:
An Act respecting the establishment of growth plan areas and growth plans

Preamble

The Government of Ontario recognizes that in order to accommodate future population growth, support economic prosperity and achieve a high quality of life for all Ontarians, planning must occur in a rational and strategic way.

The Government of Ontario recognizes that building complete and strong communities, making efficient use of existing infrastructure and preserving natural and agricultural resources will contribute to maximizing the benefits, and minimizing the costs, of growth.

The Government of Ontario recognizes that identifying where and how growth should occur will support improved global competitiveness, sustain the natural environment and provide clarity for the purpose of determining priority of infrastructure investments.

Purposes

1. The purposes of the Act are,

(a) to enable decisions about growth to be made in ways that sustain a robust economy, build strong communities and promote a healthy environment and a culture of conservation;

(b) to promote a rational and balanced approach to decisions about growth that builds on community priorities, strengths and opportunities and makes efficient use of infrastructure;

(c) to enable planning for growth in a manner that reflects a broad geographical perspective and is integrated across natural and municipal boundaries;

(d) to ensure that a long-term vision and long-term goals guide decision-making about growth and provide for the co-ordination of growth policies among all levels of government. 2005, c. 13, s. 1.

Contents of plan

6. A growth plan may contain,

(a) population projections and allocations;

(b) an assessment and identification of priority growth areas, emerging growth areas and future growth areas, over specified time periods;

(c) growth strategies for all or part of the growth plan area;

(d) policies, goals and criteria in relation to,

(i) intensification and density,
(ii) land supply for residential, employment and other uses,
(iii) expansions and amendments to the boundaries of areas of settlement,
(iv) the location of industry and commerce,
(v) the protection of sensitive and significant lands, including agricultural lands, and water resources,
(vi) non-renewable resources,
(vii) the conservation of energy,
(viii) infrastructure development, the location of infrastructure and institutions,
(ix) transportation planning,
(x) municipal waste management planning,
(xi) the co-ordination of planning and development among municipalities,
(xii) growth-related capital spending and financing,
(xiii) affordable housing,
(xiv) community design,
(xv) specified actions to be taken by municipalities to implement or achieve the policies or goals;

(e) such other policies, goals or matters that the Minister considers advisable. 2005, c. 13, s. 6.

Places to Grow Act, 2005 S.O. 2005, CHAPTER 13

Ontario Ministry of Public Infrastructure Renewal (PIR)

The Hon. David Caplan

Growth Plan for the Greater Golden Horseshoe (GGH)

"As the GGH grows, so will the overall demand for water, energy, air, and land. The ongoing availability of these natural resources is essential for the sustainability of all communities. This Plan recognizes and supports the role of municipal policy in providing leadership and innovation in developing a culture of conservation." (Ontario Growth Plan for the Greater Golden Horseshoe, p.30).

"This Plan addresses [community infrastructure] challenges through policy directions that:

- Direct growth to *built-up areas* where the capacity exists to best accommodate the expected population and employment growth, while providing strict criteria for settlement area boundary expansions.
- Promote *transit-supportive* densities and a healthy mix of residential and employment land uses
- Preserve employment areas for future economic opportunities
- Identify and support a transportation network that links *urban growth centres* through an extensive multi-modal system anchored by efficient public transit, together with highway systems for moving people and goods
- Plan for *community infrastructure* to support growth
- Ensure sustainable water and wastewater services are available to support future growth
- Identify natural systems and *prime agricultural areas*, and enhance the conservation of these valuable resources
- Support the protection and conservation of water, energy, air and cultural heritage, as well as integrated approaches to waste management. "(Ontario Growth Plan for the Greater Golden Horseshoe, p.8)

A Culture of Conservation

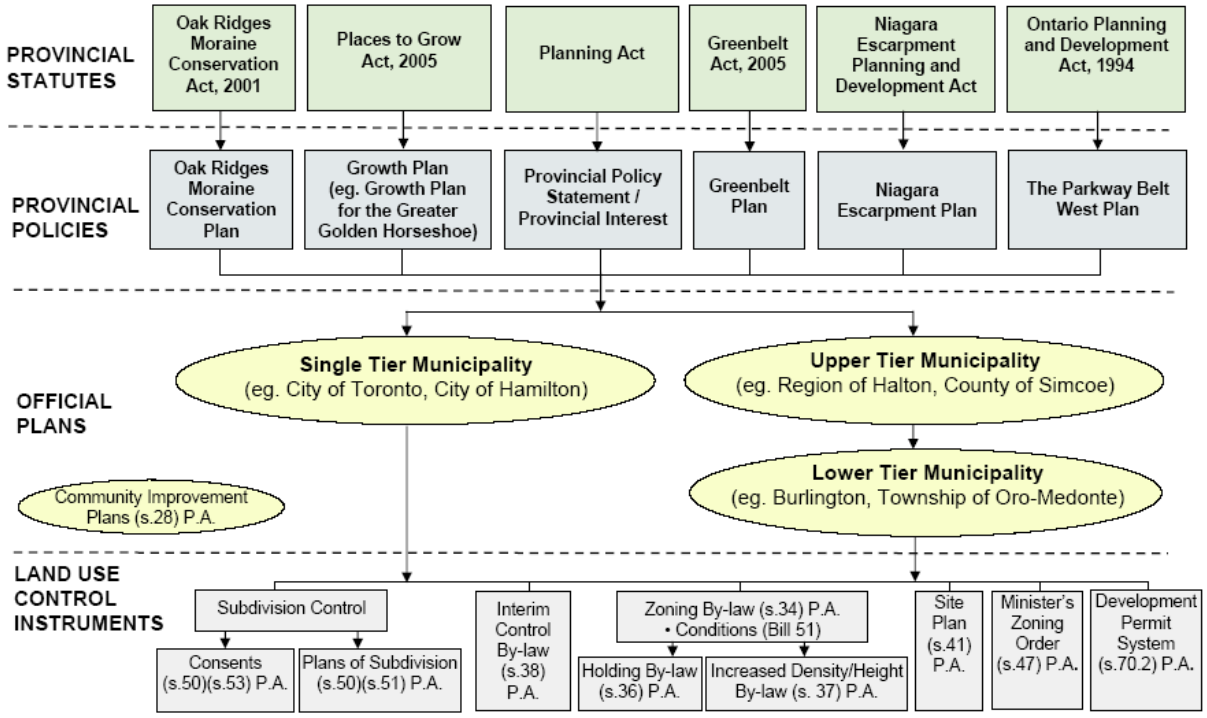
"Municipalities will develop and implement official plan policies and other strategies in support of the following conservation objectives:

1. Water conservation, including:
   - water demand management, for the efficient use of water
   - water recycling to maximize the reuse and recycling of water.
2. Energy conservation, including:
   - energy conservation for municipally owned facilities
   - identification of opportunities for alternative energy generation and distribution
   - energy demand management to reduce energy consumption
   - land-use patterns and urban design standards that encourage and support energy-efficient buildings and opportunities for cogeneration.
3. Air quality protection, including reduction in emissions from municipal and residential sources." (Ontario Growth Plan for the Greater Golden Horseshoe, p.32)

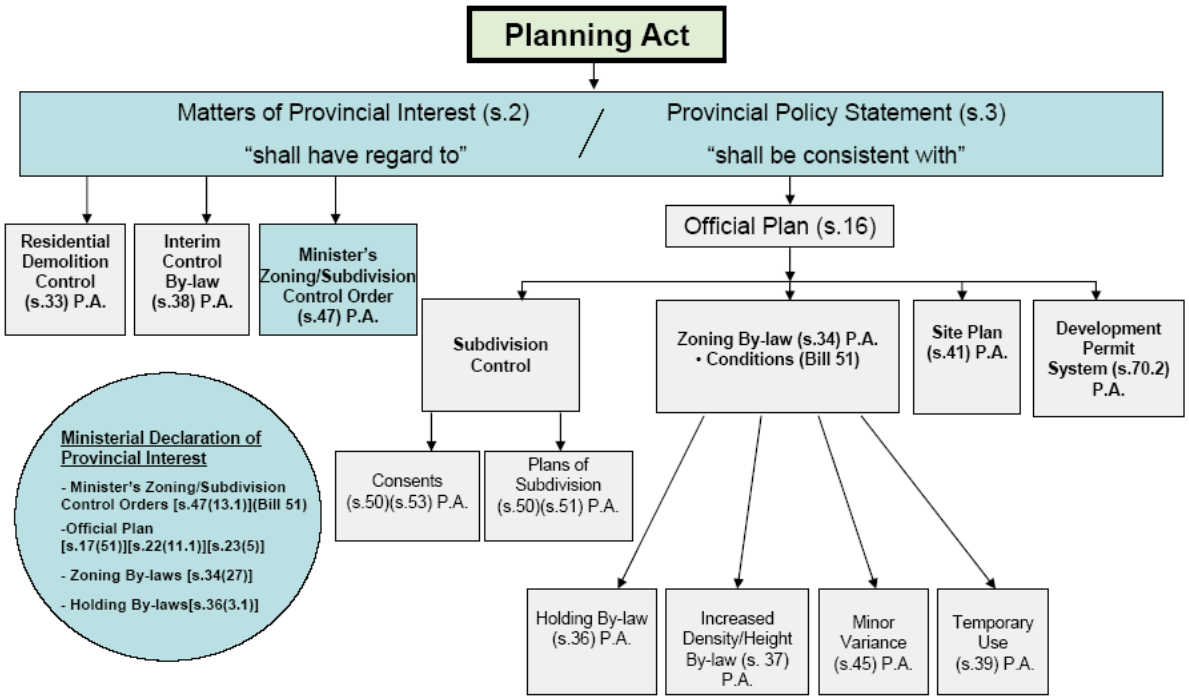
Ontario Growth Plan for the Greater Golden Horseshoe

Appendix F: Ontario - Planning Structure and Legislative Framework

The following charts visually summarize the complex Provincial / Municipal Planning Structure and Legislative Framework in the Province of Ontario.



Source: Wood Bull, 2007.



Source: Wood Bull, 2007.

Municipal Act, 2001

Provides for the following:

- Natural person powers = a municipality has the capacity, rights, powers and privileges of a natural person for the purpose of exercising its authority under this or any other Act (section 8 of the *Municipal Act, 2001*)
- Procedure by-law (section 238)
- Designation of business improvement areas (section 204)

Building Code Act

Provides for the following:

- Building permits (section 8)
- Building Code – Applicable law (section 1.1.3.3)

Appendix G: Sustainable Pickering's Local Action Plan

Summary - GHG Reductions

Municipal Operations

The municipal operations target requires a total GHG emission reduction from 1995 baseline of 6,157 tonnes by 2016. The contribution of the various Sustainable Municipal programs provides reductions of 1130 tonnes from existing buildings retrofits, 2500 tonnes from new buildings, 990 tonnes from fleet management and an undetermined amount from other programs. With a current reduction of 0.01 tonnes per year as of 2004, this equates to a total per capita reduction of 0.04 tonnes per year with another 0.01 tonnes per year yet to be quantified to achieve the target reduction of 0.05 tonnes per year.

Although relamping street lighting could theoretically provide a reduction of 0.01 tonnes per year, the peak loading in Ontario is such that reduction in electricity in night time non-peak hours does not appreciably reduce GHG emissions as this tends to impact GHG-free nuclear power generation loading. Also, new off-peak hour electricity pricing will reflect this reality as smart meters are installed, so the economic case will also be less attractive. As the other programs are quantified such that they further compound savings in building and fleet efficiency, the remaining 20% reductions to achieve target will not be overly burdensome. To put this in perspective, roughly 2/3 of potential energy savings in buildings is from operational and/or behavioural changes and 1/3 from capital retrofits. Only the retrofit changes have been taken into account thus far.

Community

The community target requires a total GHG emissions reduction from 1995 baseline of 258,595 tonnes by 2016. The contribution of the various community programs provides reductions of 141,000 tonnes from the Sustainable Homes program, 41,000 tonnes from the Sustainable Workplace and Sustainable School programs, 50,000 tonnes from the Sustainable Transportation program, and 38,000 tonnes from the Sustainable Land program. With a current reduction of 1.0 tonnes per person as of 2004, this equates to a total per capita reduction of 2.9 tonnes per person, which exceeds the target of a 2.8 tonnes per person reduction.

PCP Local action Plan

Recommendations and Next Steps

Recommendations for Council

The following are recommendations to council concerning adoption of milestones 1, 2 & 3 of the PCP framework:

1) Adopt 1995 as the baseline year and 2016 as the target year for GHG inventory and forecast calculations. The GHG emission inventory and forecast information presented in this report completes the PCP requirements for Milestone 1.

2) Commit to reduce GHG emissions for the entire community by 35% on a per capita basis by 2016 from 1995 levels, which will include a 50% per capita reduction in municipal operation emissions. This commitment completes PCP Milestone 2.

3) Adopt this PCP Local Action Plan as a working document in proceeding to the next stage of implementation of programs and initiatives. Adoption of this report completes the requirements for PCP Milestone 3. Adoption of this report does not commit council to the approval of specific implementation initiatives. Initiatives and programs that require council approval will be submitted at a later date as part of Milestone 4 (implementation stage) when further program quantification and funding is ascertained.

Next Steps

There are many implementation suggestions in the action plan, however the following next steps are the most pertinent:

1) Obtain funding for the creation of new full-time position to coordinate all sustainability programs outlined in this action plan plus other relevant initiatives under the Sustainable Pickering program. Private sector funding could potentially be ascertained for this position on a three year contract.

2) Develop a phased implementation plan with estimated start-up costs and operating costs for each program.

3) Continue to engage stakeholders and potential funding partners for milestone 4 program implementation.

4) Develop funding strategies and applications for relevant programs.

5) Develop a budget for any of the above work that needs to be contracted.

Source: Sustainable Pickering LAP 2006, 59.

Appendix H: Enbridge SWOT Analysis

Strengths

Intellectual Capital
- BD&S group has the knowledge and vision of emerging energy technologies and how they work conceptually & understanding of how they can be integrated into current energy systems.
- Research Capabilities: able to monitor and understand stakeholders' positions
- In-depth understanding of the future energy market and how energy may be delivered as heating or electricity in the foreseeable future
- Able to account for both threats to traditional gas loads and opportunities for EGD to leverage SCEP for increased growth margins.

Depth of resources
- $5 billion of in-situ assets to leverage for SCEP projects.
- Internal management processes to track, quantify and report on emissions reductions, etc.

Reach and Influence
- Exceptional government relations and access to political decision-makers
- Ability to quickly, efficiently and easily reach 1.8 million customers on a regular basis.
- Growing customer base (45k per year)
- Natural monopoly position limits competition

Product and Reputation
- Natural Gas is the cleanest of fossil fuels
- Brand equity with the customer
- Customer relationship via the bill
- reputation as an unbiased provider of energy information (and energy service)

Forward-Thinking Culture
- Management willing to investigate and pursue new lines of business
- A long-term coordinated plan for growth and development approaches to be undertaken

Weaknesses

Risk Tolerance
Corporate tolerance of financial risk (a focus on short term rather than long term returns and an adherence to specified and fixed ROIs may exclude experimentation in potentially lucrative new lines of business that have steep learning curves).

Regulatory Uncertainty
Transition from COS to IR, and the unknown variables associated with a new regulatory model, further compounds senior management's "risk tolerance" regarding new business models and revenue opportunities.

Corporation "in transition"
Existing internal corporate structure and culture makes "connecting the dots" difficult.

Nature of large corporation makes decision-making a long process, therefore, slow to respond and commit to new opportunities

Current corporate structure has developed as a direct result of regulated monopoly requirements and is not necessarily suited to the pursuit of entrepreneurial ventures.

Corporate structure and legal entity necessary to function effectively in SCEP ventures is not known at this point.

Gap in capabilities (internal)
EGD has expert staff, knowledgeable in natural gas distribution business, however, these skill sets are not necessarily transferable to the deployment of renewable energy technologies.

- Natural gas remains a fossil fuel (best of worst)
- Declining average use of Natural Gas

Opportunities

Ontario Government promoting a Green Energy Strategy and IPSP promoting Renewable Energy

Opportunity to expand Enbridge into an energy distributor, providing a mix of energy not just NG.

SCEP and our changing energy paradigm:

- Urban intensification and infill often the best opportunities due to economies of scale inherent in these developments (spread capital costs across a larger potential customer base).
- Greenfield developments - single family residential. Partner with municipalities (i.e. East Gwillimbury), engaged third parties (i.e.TRCA) and builders/developers looking for an opportunity to differentiate their marketplace value proposition to provide combinations of green energy applications.
- Retrofit existing single-family detached housing is a potential secondary market (not as lucrative as it incurs greater costs per unit).

Leverage the trust, reliability and reputation of the Enbridge's brand in the consumers' mind.

"Expectation" (of Enbridge's customers) that the company will enter the renewables marketplace, soon – as noted by Strategic Counsel research.

Trust by customers bodes well for Enbridge to give renewables our "stamp of approval"

Ability to incorporate a separate legal entity or offer a renewable energy solution through an unregulated utility – i.e. Enbridge Solutions, Inc.

Possibility of providing a suite of carbon-reduction and management services.

Broad range of "state-of-the-art" environmental programs already in place and recognized by senior management, employees and the business community.

"One-Bill" – Opportunity to leverage Enbridge's current reach of 1.8 million customers to create "one-bill" for a variety of SCEP services that could be offered by EGD or a variety of niche energy providers.

Threats

Ever changing energy supply priorities reflective of government policies "of-the-day" can change the financial and policy support of green initiatives.

Energy Mix

- Future of natural gas in Ontario's energy mix is being questioned by IPSP
- Role of fossil fuels is under scrutiny due to GHG emissions & climate change adaptation policy.

Regulatory Veto and Control

- OEB approval needed to change the company's business model as it is the final decision-maker of the regulated utility.
- OEB and company vision may differ (under IR)

Stakeholder expectations:

- (and actions) on a broad range of environmental issues
- as to how EGD will act in a carbon-constrained future.

Market and Consumer

- may not be willing to PAY for more expensive green alternatives, although they SAY they will.
- How the competition positions their services in a carbon-constrained future.
- Increased consumer choice (and confusion) in the marketplace.
- perception and reputation of fossil fuels may worsen as carbon-constraint intensifies.

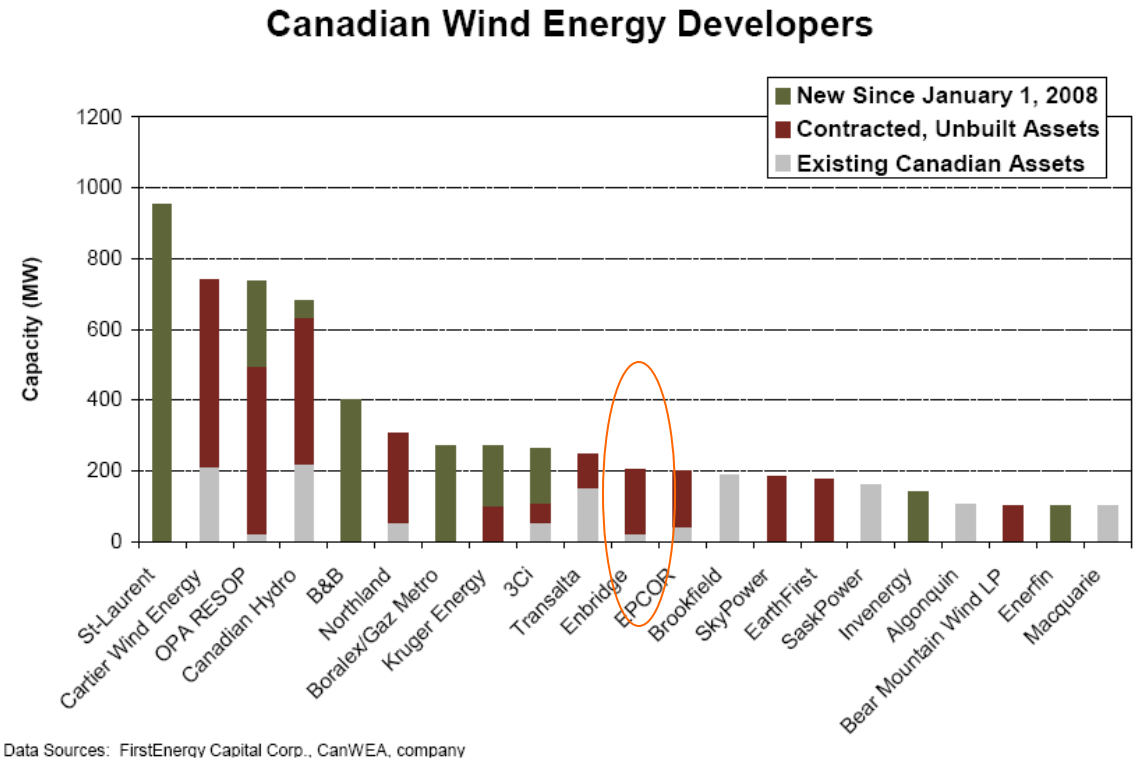
Corporate Culture

- Length of time to take an idea to market may result in missed opportunities (large corporation vs. entrepreneurial entity).
- Risk tolerance associated with these new technologies may be too high for executive management to bear

"Feed-In Tariff" is still in "price discovery mode". Currently $0.42 is generally not profitable and price is likely to decrease.

Gap in Capabilities (External)
Availability of qualified trades to install and maintain new technologies – may have to engage in educational programs and certification programs.

Appendix I: Canadian Wind Energy Developers



Source: First Energy Capital Corporation 2008 and CanWEA.

Appendix J: Markham District Energy's Initiatives

GMEF 3645 - Energy from Waste Feasibility Study: A Future Fuel Source for Markham's District Energy System

GMF Category: Solid Waste Management	
Municipality: Town of Markham, Ontario	**Total Project Value:** $38,105.00
Population: 173,383	**Grant Amount:** $19,052.00
	Loan Amount: $0.00
Project Contact: Mr. Bruce Ander, President, Markham District Energy (902) 787-3500	**FY Approved:** 2004 – 2005

Markham District Energy Inc. (MDEI) will look at the economic and technical feasibility of using fuel extracted from organic waste for its district heating system (DES). This is the first Canadian study of blending biogas with natural gas to fuel an urban-sited district energy plant. There is also the potential that the fuel could be used for the production of both electricity and thermal energy (hot water, steam or chilled water). Expected benefits are threefold: provide local waste management and processing solutions; allow MDEI to hedge the volatility and high cost of natural gas; and lower greenhouse gas (GHG) emissions and contribute to improved air quality. A high value-for-cost project with a good potential for reduction of GHG emissions, this project will complement other studies on waste management plans and anaerobic digester projects.

Source: FCM GMF: http://www.sustainablecommunities.fcm.ca/Search/Search/Search.aspx?lang=e

GMIF 5023 - District Energy Capital Expansion Project

GMF Category: Energy	
Municipality: Town of Markham, Ontario	**Total Project Value:** $11,000,000.00
Population: 173,383	**Grant Amount:** $1,500,000.00
	Loan Amount: $4,000,000.00
Project Contact: Mr. Bruce Ander, President, Markham District Energy Inc. (905) 513-4164	**FY Approved:** 2003 – 2004

This pilot project represents Phase 2 of development of Markham's Smart Growth downtown, Markham Centre - the largest greenfield urban planning project in North America with a planning area of 988 acres and upwards of 15 million square feet of residential, commercial and institutional buildings. Markham District Energy Inc. (MDEI), created in 2000 to offer an environmentally sustainable energy solution to developers, and the Town are working towards having over 90 per cent of the developed square footage of Markham Centre connected to the community energy system. This pilot project will expand the distribution system northwards and eastwards, with infill of the existing system and installation of chilled water storage technology and efficiency upgrades. These activities are necessary to grow the customer base to match the heating and cooling capacity currently available from MDEI's existing plant and to attract more customers. The current MDEI production facility has a combined heat and power (CHP) plant (3.5 megawatt (MW) electrical and 3.2 MW thermal capacity) plus additional high efficiency boilers (10 MW capacity) and absorption chillers (1.5 MW capacity). It is estimated that once the current capacity of the CHP plant is reached (at 10 Mw peak heating load), the district energy system will require approximately 25% as much natural gas as the alternative (individual furnaces). This equates to natural gas savings of 1.7 million cubic metres and GHG reductions of approximately 3,200 tonnes of CO_2 equivalent per year.

Source: FCM GMF: http://www.sustainablecommunities.fcm.ca/Search/Search/Search.aspx?lang=e

Appendix K: Drake Landing Demonstration Project – Okotoks, Alberta

- 52-house subdivision to have space and water heating supplied by solar energy
- Solar energy captured year round by 800-panel garage mounted array
- Combination of seasonal and short-term thermal storage (STTS) facilitate collection and storage of solar energy in the summer for use in space heating in winter
- Borehole thermal energy storage (BTES) is an in-ground heat sink for seasonal energy storage
- Short-term thermal storage (STTS) tanks are central hub for heat movement between collectors, district loop (DL)/houses, and (BTES)
- DL moves heat from the STTS to the houses

Location: Okotoks, Alberta. 51.1 deg N, 114 deg W, 1084 m elevation
Weather: Winter -33 C; Summer 28.3 C DB/15.6 C WB

This 52-house subdivision is the first solar seasonal storage community in North America a "BTES Technology Demonstration Project". More than 90% of space heating needs are supplied by solar fraction resulting in a reduction of 4-5 tonnes GHG per home per year. It is also the largest subdivision of R-2000 single family homes in Canada.

Source: Bill Wong and Aart Snijders 2007.

Source: Drake Landing website.

How it Works[20]: Capturing the Solar Thermal Energy

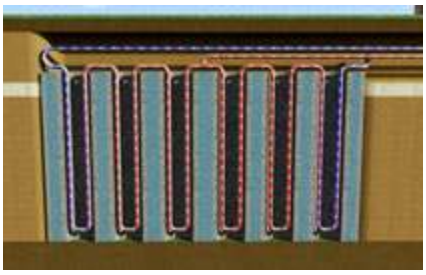
An array of 800 solar panels located on garage roofs throughout the community generate 1.5 mega-watts of thermal power during a typical summer day and supply heat to the district heating system. From sunrise to sunset, the solar panels absorb the Sun's energy and heat a glycol solution running through an insulated piping system, or collector loop,

[20] Drake Landing Website. Retrieved on July 25, 2008 from http://www.dlsc.ca/how.htm

that connects the array of collectors. The heated glycol travels along the roof overhang, down the end of the garage, and underground through a shallow buried trench system until it arrives at a heat exchanger within the community's Energy Centre. The heat exchanger transfers heat to the water stored in a short-term storage tank. The glycol solution carries on through its loop back to the solar collector system.

Storing the Solar Thermal Energy

During the warmer months, the heated water is distributed from the short-term storage tank to the borehole thermal energy storage (BTES) system via a series of pipes. The pipes run through a collection of 144 holes that stretch thirty-seven meters below the ground and cover an area thirty-five metres in diameter.



Sample heat flow through boreholes.

As the heated water travels through the pipe-work, heat is transferred to the surrounding earth. The temperature of the earth will reach 80 degrees Celsius by the end of each summer.

To keep the heat in, the BTES is covered with sand, high-density R-40 insulation, a waterproof membrane, clay, and other landscaping materials.

The water completes its circuit of the borehole system and returns to the short-term storage tanks in the Energy Centre to be heated again and repeat the same process.

Distributing the Solar Thermal Energy

When winter arrives and the homes require space heating, the heated water in the BTES passes to the short-term storage tank in the Energy Centre and is then circulated to the homes through the district heating loop.

Reaching each home the heated water passes through a heat exchanger within a specially designed, low-temperature air handler unit located in the basement. A fan, also within the unit, blows air across the warm fan coil. Heat is passed from water to air and then distributed throughout the house via the home's ductwork.

When the temperature of the home's thermostat is met, an automatic valve in the basement shuts off the heat transfer between the district heating loop and the air handler unit.

Heat Transfer throughout the System

The system only initiates heat transfer when the temperature within a preceding component rises higher than the temperature within a succeeding component. For example, as the sun rises and the solar collectors heat up, the collector loop is turned on once the glycol temperature rises above the temperature of the water in the Energy Centre's short-term storage tanks (STTS). Energy is then transferred from the collectors to the STTS.

Similarly, after the water temperature in the STTS rises above the BTES temperature, the BTES pump is turned on to transfer heat from the STTS to the BTES. The collectors will heat up the STTS about twice as fast as the BTES can remove heat from the STTS. Consequently the collector pump will shut off when the sun goes down while the BTES pump will run most of the night.

When the houses need heating in the wintertime the heat from the collectors will be directed from the STTS into the district heating loop, and not transferred to the BTES. The district heating loop temperature varies with outdoor air temperature. As it gets colder outside the district heating loop temperature is raised. This temperature is regulated by the heat exchanger between the STTS and the district heating

loop. If the STTS, in conjunction with the heat provided by the collectors, is not hot enough to meet the demands of the district heating loop, then heat from the BTES is transferred to the STTS for use.

If the STTS still cannot meet the demand for heat, the Energy Centre's back-up gas boiler will turn on to increase the temperature.

Borehole Thermal Energy Storage (BTES)[21]

- 144 – 150mm dia x 35m deep boreholes spaced 2.25m on centre.
- Single 25mm PEX U-tube with 40mm grout tube.
- High solids grout – 9% Blast Furnace Cement, 9% Portland cement, 32% fine silica sand, 50% water
- 24 strings of 6 boreholes in series.
- Divided into four circuits and distributed through four quadrants so that the loss of any single string or circuit has minimal impact on the heat capacity on the entire system
- All circuits and strings start from centre of the BTES and move toward the outside to maximize stratification.

A borehole thermal energy storage (BTES) system is an underground structure for storing large quantities of solar heat collected in summer for use later in winter. It is basically a large, underground heat exchanger. A BTES consists of an array of boreholes resembling standard drilled wells. After drilling, a plastic pipe with a "U" bend at the bottom is inserted down the borehole. To provide good thermal contact with the surrounding soil, the borehole is then filled with a high thermal conductivity grouting material.

The BTES in the Drake Landing Solar Community (DLSC) consists of 144 boreholes, each stretching to a depth of 37 meters and planned in a grid with 2.25 meters between them. The BTES field covers 35 metres in diameter. At the surface, the U-pipes are joined together in groups of six that radiate from the center to the outer edge, and then connect back to the Energy Centre building. The entire BTES field is then covered in a layer of insulation and then soil – with a landscaped park built on top.

When solar heated water is available to be stored, it is pumped into the centre of the BTES field and through the U-pipe series. Heat is transferred to the surrounding soil and rock, and the water gradually cools as it reaches the outer edge and returns to the Energy Centre.

Conversely, when the homes require heat, cooler water is pumped into the edges of the BTES field and as the water flows to the centre it picks up heat. The heated water passes to the short-term storage tank in the Energy Centre and is then circulated to the homes through the district heating loop. All pumps and control valves are housed in the neighbouring Energy Centre building.

Even with sunny Alberta weather, it will take approximately three years to fully charge the BTES field. In the first years of operation, the field will operate at relatively low temperatures, and the recoverable energy will be largely depleted before the end of the heating season. However, after a few years of operation, the core temperature of the BTES field will approach 80°C by the end of summer, with sufficient heat for almost an entire heating season.

[21] Drake Landing Website. Retrieved on July 25, 2008 from http://www.dlsc.ca/borehole.htm

Appendix L: Guelph Community Energy Plan

Garforth International llc

Energy Productivity Solutions

City of Guelph Community Energy Plan

CITY OF GUELPH COMMUNITY ENERGY PLAN

Final Report dated 16th March 2007

Prepared For
Guelph Community Energy Plan Consortium

Guelph Community Energy Plan
Vision and Goals

Guelph will create a healthy, reliable and sustainable energy future by continually increasing the effectiveness of how we use and manage our energy and water resources

Goals

1. Guelph will be the place to invest supported by its commitment to a sustainable energy future

2. Guelph will have a variety of reliable, competitive energy, water, and transport services available to all

3. Guelph energy use per capita and resulting greenhouse gas emissions will be less than the current global average

4. Guelph will use less energy and water per capita than comparable Canadian cities

5. All publicly funded investments will visibly contribute to meeting the four CEP goals

Guelph Community Energy Plan
Prioritized strategies 2007-2031

- High construction efficiency standards
  - *EU and California levels*
  - *Certified energy performance*
  - *New and renovations*
- Transport Efficiency
  - *40% vehicle efficiency gain*
  - *Mass transit routes*
  - *Neighbourhood design*
- Heat recovery
  - *Modern district heating system*
  - *Electricity generation with heat recovery*
- Renewable
  - *"1000 Solar Roofs"*
  - *Biomass heating for 20% of heating needs*
  - *Biodiesel distribution*
- Teamed with local gas and electric utilities
- Selected "Scale Projects"

2031 Targets from Community Energy Plan

Sector	2005 GWh_e/yr	2031 GWh_e/yr	2005 MWh_e/cap	2031 MWh_e/cap
Residential	1,610	1,473	14.00	8.18
Commercial	1,046	1,076	9.10	5.98
Industrial	1,631	1,848	14.18	10.27
Transport	1,743	1,126	15.16	6.26
Total (Net)	**6,030**	**5,523**	**52.44**	**30.68**
Electrical conv.	2,445	612	21.26	3.40
Total (Gross)	**8,475**	**6,135**	**74.04**	**34.08**

- Population grows to 180,000 from 115,000
- Greenhouse Gas Per Capita:
  - *7.0 Tonnes in 2031 from 16 Tonnes in 2007*

Energy for growth from productivity

Successful City Energy Master Plan
Prioritization and Long-Term Commitment

1. Energy efficiency – ***If you don't need it don't use it***
   - *Efficient buildings*
   - *Design for transport efficiency*
2. Heat Recovery – ***It it's already there – use it***
   - *Cogeneration*
   - *Industrial waste heat*
3. Renewable energy – ***If it makes sense, go carbon free***
   - *Solar Electric and Thermal*
   - *Biogas and Biomass*
   - *City Waste as a fuel*
   - *Wind*
4. Regional and local distribution – ***Invest where it makes sense***
   - *Teaming gas and electricity companies*
   - *Flexible distribution – electricity, gas, heating,*
   - *Accepts multiple fuels and energy conversion technologies*

.

Leadership, Discipline and Cooperation

Scale Projects
Critical to Successful CEP Implementation

Community Energy Plan

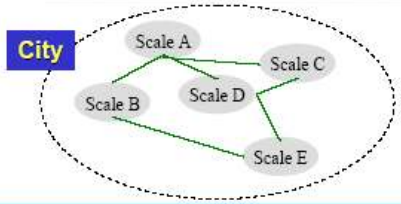
- Typical Goals
  - *30 to 60% less energy*
  - *40 to 80% less GHG*
  - *Affordable energy*
  - *Attract investment*
  - *Reduce city costs*
- Will they be implemented?

Scale Projects

- Success needs scale
- Multiple winners
  - *City, developer, utility…*
- Potential projects
  - *High density urban villages*
  - *Industrial estates*
  - *Greenfield Smart Growth*
  - *Recreation Centres*
  - *Transportation facilities*
- "Connect the Dots"

Efficient Buildings

- Solid programmes
  - *Energy Star*
  - *NR Canada….*
- Quality resources
  - *Construction guides*
  - *Efficient equipment*
  - *Rebate and incentives*
  - *Training & education*
- Limited penetration
  - *Few new buildings exceeds code*
  - *Fewer remodeling exceed code*



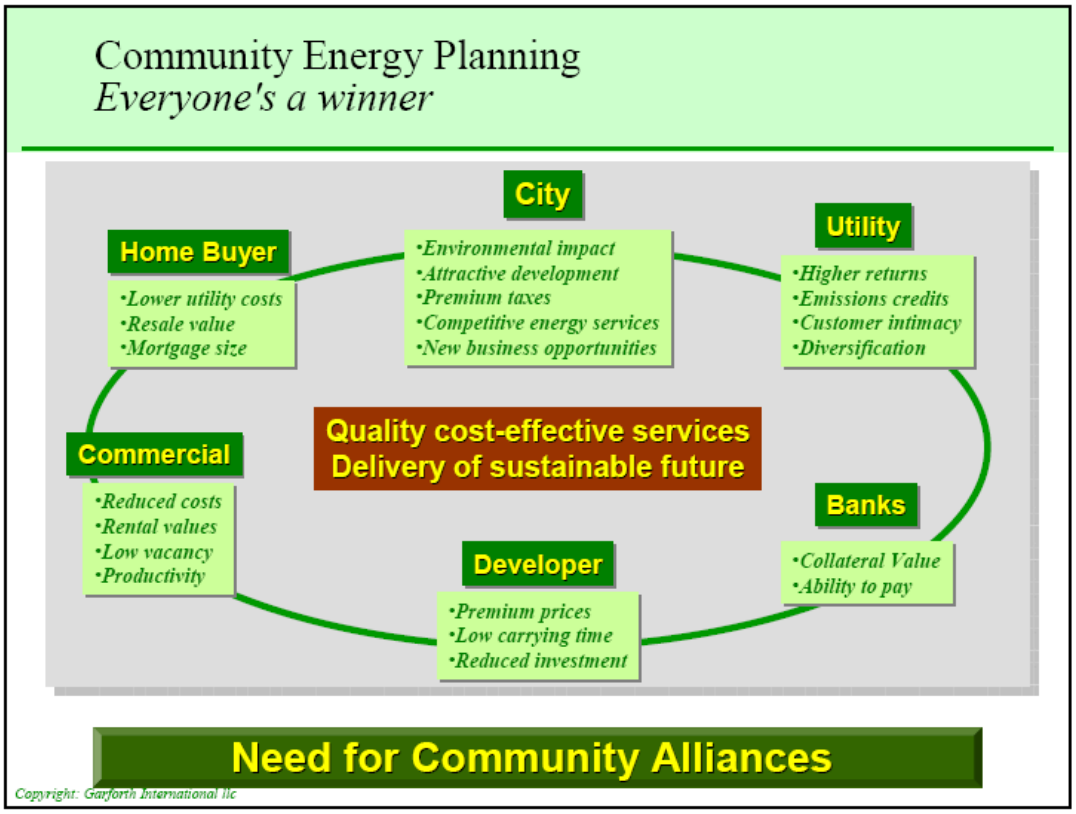
Scale Projects Bridge the Gap

Typical Scale Projects

- High density urban villages
  - *Areas targeted for urban renewal*
  - *High density mixed-use development*
  - *Usually covering at least 50 hectares.*
- Greenfield Smart Growth
  - *Trend for mixed use, greenfield developments*
  - *Reduce sprawl and create livable communities*
  - *Create opportunity for innovative energy solutions.*
  - *High-density residential with commercial/retail development*
- Industrial Estates / Commercial Centres
  - *New or existing industrial estates where high quality, tailored energy services could attract quality investment*
  - *Major retail or commercial centres*

Typical Scale Projects

- Sports and Recreation Centers
  - *Auditoria, swimming pools, ice rinks, gymnasia ..*
  - *Long opening hours and high energy*
  - *Public facilities with energy costs as significant challenges*
- Transportation Facilities
  - *Airports, railway centers, multi-modal transport interchanges*
  - *Similar energy characteristics to sports centers.*
- Academic Campuses
  - *Developed over time with no integrated approach*
  - *Large energy consumers, frequently challenged by budgets.*
  - *Accountable to form the ideas of the future*
- Plan for combinations
  - *Anticipate linkages between projects*
  - *Benefits from differing energy times-of-use or applications*


Community Energy Planning
Everyone's a winner
City
Home Buyer
•Lower utility costs
•Resale value
•Mortgage size
•Environmental impact
•Attractive development
•Premium taxes
•Competitive energy services
•New business opportunities
Utility
•Higher returns
•Emissions credits
•Customer intimacy
•Diversification
Quality cost-effective services
Delivery of sustainable future
Commercial
•Reduced costs
•Rental values
•Low vacancy
•Productivity
Banks
•Collateral Value
•Ability to pay
Developer
•Premium prices
•Low carrying time
•Reduced investment
Need for Community Alliances
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Appendix M: SCEP Funding Sources

FCM's Green Municipal Fund (GMF)

GMF provides loans and grants, builds capacity, and shares knowledge to support municipal governments and their partners in developing communities that are more environmentally, socially and economically sustainable. The fund was established by the Government of Canada with a $550 million endowment with the aim of providing a long-term, sustainable source of financing for municipal governments and their partners. To ensure the greatest possible impact, FCM uses GMF to invest in plans, studies and projects that provide the best examples of municipal leadership in sustainable development and that can be replicated in other communities. FCM develops case studies and other tools to support municipal governments that are prepared to follow these examples. (GMF website).

Initiative	Pre-requisites?	Available funding	Assessment criteria
Plans **Sustainable Community Plans**	Council resolution to establish a vision for sustainability and targets to achieve it	Grants for up to 50% of costs to a maximum of $350,000	Management capacity and workplan Budget and cost effectiveness Systems approach Links to existing plans Sustainability considerations Innovation Replication potential Knowledge sharing potential
Studies **Feasibility Studies and Field Tests** related to brownfields, energy, transportation, waste, water	• Sustainable community plan or sector plan that includes sector-specific targets • Other sector-specific prerequisites listed in the Guidelines	Grants for up to 50% of costs to a maximum of $350,000	Management capacity and workplan Budget and cost effectiveness Systems approach Links to existing plans Sustainability considerations Environmental, social and economic benefits Innovation Replication potential Knowledge sharing potential
Projects **Capital Projects** related to brownfields, energy, transportation, waste, water	Specific to each call for applications. Common pre-requisites include links to sustainable community plan, or favourable feasibility study or field test	Loans and loans with grants up to 80% of costs	Specific to each call for applications

Source: FCM GMF website: http://www.sustainablecommunities.fcm.ca/GMF/.

Other SCEP Funding Sources

Financing Strategies[22]**:** From a municipality's perspective there are many strategies to choose from when considering how to finance energy-related initiatives in their community, several of the options are outlined below:

Joint Ventures: A joint venture involves partnerships, either in financing or implementation or both

[22] Retrieved on July 20, 2008 from http://www.communityenergy.bc.ca/strategies-for-financing

Public-Public Partnerships: These can be either across departments within a government, or across levels of government. Partnerships may involve giving budgetary recognition to non-energy capital and operating cost savings that result from energy efficiency. For example, low-flow showerheads reduce energy bills, but also save on expenditures for new water supply and treatment infrastructure. If all departments calculate their collective energy bills, and collaborate to figure out what energy conservation measures will mean to water and wastewater costs, then joint planning and financing opportunities may emerge.

Public-Private Partnerships: Local governments often rely on private capital to achieve economies that taxpayers and internal and intergovernmental barriers won't let them exploit. If up-front costs are a barrier to a project that generates an acceptable rate of return in the long term, look for private investors that may have an interest in the project. Offset funding may be an option. Some utilities, agencies or industries are required by law to meet certain standards (such as environmental or efficiency standards). If a municipality has lower-cost options for meeting these targets, they may be able to implement programs in exchange for funding assistance. For example, instead of costly upgrades to air pollution equipment at generation facilities, a utility might fund a van pooling program to achieve the same reduction in air emissions at lower cost (see inset).

Third Party Financing: While joint ventures imply shared responsibility for implementation, third party financing means bringing in an external party simply to pay up-front costs. There are a number of players that could be involved.

Energy Service Companies: Energy Service Companies (ESCO's), are private firms that offer technical and financing services for energy supply and efficiency investments. ESCo's are a large and growing business in North America. They can put up the up-front money and split the annual energy savings with the government. In this way, operating expenditures savings are "capitalized". The local economy can even benefit from having government pay for ESCO services in the design of infrastructure, sharing in the capital cost savings inherent in energy-efficient design.

Financial Institutions: Many banks, trust companies and credit unions are starting to develop energy efficiency-related financial services.

Lease-purchase agreements: This is a rental agreement in which an Energy Service Company or utility rents equipment, and perhaps related services, to the municipality. At the end of the lease, the municipality can buy the equipment at a nominal cost.

Fees and Taxes: User Fees, Surcharges and Surtaxes: User fees, surcharges and surtaxes are often considered as merely a means of recovering costs. However, they can also be designed to create incentives for preferred activities. Most public opposition to additional charges can be alleviated by designing them to be revenue-neutral and keeping the costs and benefits within the same sector or user group. For example, Ontario's "feebate" system uses surcharges on inefficient cars to finance refunds to buyers of efficient cars.

Development Cost Charges: These are explicit charges by the municipality or region that serve both to cover the up-front costs of servicing new growth, and, if properly designed, to encourage preferred patterns of development (see Part II, Energy Ideas for Municipal and Regional Infrastructure and Facilities).

Property Tax Changes: An important long term energy efficiency investment is the geographic "de-averaging" of property tax rates. From sewer lines to bus routes, the costs of providing services to low-density neighbourhoods are higher than for dense ones. But they're buried in uniform taxes. Besides improving efficiency, charging homes and businesses in proportion to the costs they incur will help to re-vitalize core areas.

Profit and budget control are powerful forces: if an energy efficiency measure makes or saves money, there must be a way to finance it. The challenges are measuring the savings properly and creating incentives for working together.

Appendix N: Community Energy Key Principles

From the United States Department of Energy (US DOE) Principles[23]

Community Energy Programs can take many forms and depend upon the specific goals, resources and conditions of the community. Below are some ideas to help in this process:

Communities and Demand-Side Management (DSM) Programs
Utilities can design and deliver tailored programs that address specific goals.

Community Industrial Efficiency Programs
Industrial operations consume a large amount of energy and contribute to pollution problems. Together, community organizations, utility companies, and industrial firms can design energy programs that help these operations reduce their energy consumption and the corresponding harmful effects on the environment.

Community Buildings Efficiency Programs
Addressing energy conservation in buildings can be very effective. Efforts to weatherize homes, reduce energy use in municipal buildings and schools, and make commercial buildings operate more efficiently can save consumers and municipalities money, ease budget constraints, and help reduce pollution.

Community Renewable Energy Programs
Programs that rely on renewable energy resources (wind, solar, and geothermal), can go a long way toward reducing your community's consumption of fossil-fuel energy by reducing demand on utility power supplies and they are largely non-polluting.

Communities and Green Power Programs
A number of communities, utilities, and government agencies are putting "green power" programs in place to offer more choice to consumers about where their energy comes from. Green power is energy produced from renewable energy sources, such as solar, wind, geothermal energy, and landfill gas. These energy sources have dramatically lower pollution emissions and cause much less environmental damage than fossil fuels.

Pollution Prevention / Reduction
The production and use of energy causes pollution, which is both damaging to the environment and harmful to public health. Programs that strive to reduce energy consumption will help preserve the environment and improve air quality.

Energy Use and Community Economic Development
Reducing energy consumption your community can stimulate economic growth. By lowering energy bills, businesses increase their profits and consumers have more money to spend in the local economy. In addition, energy efficiency programs create new jobs through demand for related products and services.

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